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Special Technical Report No. 1

BIBLIOGRAPHY ON ELECTROSTATIC PHENOMENA IN AEROSOL DISSEMINATION

Prepared for:

COMMANDING OFFICER
U.S. ARMY CHEMICAL RESEARCH AND
DEVELOPMENT LABORATORIES
EDGEWOOD ARSENAL, MARYLAND

ATTN: MR. JACOB CHERNACK
CHIEF, WEAPONS RESEARCH DIVISION CONTRACT DA-18-035-AMC-122(A)

STANFORD RESEARCH INSTITUTE

MENLO PARK, CALIFORNIA *SRI

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STANFORD RESEARCH INSTITUTE
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August 2, 1965

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ABSTRACT

This bibliography represents a surve of published information relevant to the manner in which electrostatic phenomena might influence dissemination of chemical warfare agents, covering both the open literature and reports of government-sponsored research. Abstracts are included for most of the 1028 references cited.

CONTENTS

INTRODUCTION

This bibliographic survey was undertaken to reveal information relevant to the influence of electrostatic phenomena in dissemination of chemical warfare agents. Pertinent to the survey are all ways in which electrostatic charges or fields, (1) could affect the properties of materials (powders, solids, liquids, or aerosols) or the physical or chemical behavior of materials, (2) could be utilized for purposes of dissemination, (3) could be generated, controlled, or dispelled, or (4) could be measured. A critical analysis based on the information provided by this survey will appear as a chapter entitled "Electrostatic Phenomena" in another report entitled "Aerosol Dissemination Processes--A Critical Review."

The survey was conducted in three phases: (a) a primary survey covering open literature appearing through the end of September 30, 1964; (b) a supplementary survey of the open literature through May 31, 1965, including additional references missed in the primary survey and revealed during the actual analysis of articles obtained as the result of the primary survey, and (c) a review of government-sponsored research projects.

The common reference sources consulted for the primary survey are summarized in Table I. In addition to these sources, other private sources were also consulted, including Stanford Research Institute files, files of individuals, and listings obtained from CRDL.

In the supplementary survey all the reference sources indicated in Table I for the period September 30, 1964 to May 31, 1965, as well as the additional sources listed in Table II were examined. During this phase additional references were also found as various specific articles were analyzed, and were included in the supplementary list.

References to government project reports were obtained (1) by reference to contractors known to have worked in this area, (2) by reference to specific private and CRDL listings, (3) by review of files at the

Sunnyvale, California, Center of DDC, and (4) by reference from some of the sources listed in Table I.

Although it was intended to have a reasonably comprehensive survey, much of the pertinent information is to be found in other related areas. Since many of these areas are quite large in themselves, no attempt was made to be all-inclusive in each area, although it is felt that a sufficient collection of articles was obtained in these areas to be reasonably representative of the more important aspects. These related areas that were not comprehensively surveyed include: (1) electrical discharge in gases, (2) ion propulsion, (3) electrical contacts and switch gear, (4) electrets and ferroelectrics, (5) polarization of materials, (6) electrostatic printing, (7) atmospheric electricity, (8) effect of charges or electric fields on material properties, and (9) electrolysis, electrical endosmosis, electrophoresis, and electrodialysis.

The references are listed alphabetically by the last name of the first author, with the most recent article of that author given first. Where available, the reference is followed by an abstract, with the abstract source indicated by code at the end of the abstract. This code is identified in Tables I and II and is the abbreviation given in the first column. When the abstract was by the author, the word "Author" is indicated as the abstract source.

The following individuals or organizations are extended special thanks for their permission to include their copyrighted materials.

Prof. K. J. De Juhasz ("Spray Literature Abstracts")

Academic Press (J. Coll. Sci.)

American Institute of Physics (J. Chem. Phys., Rev. Sci. Instr., J. Appl. Phys., Soviet Phys.-Tech. Phys.)

American Physical Society (Phys. Rev.)

American Society of Mech. Engrs. (Applied Mech. Rev.)

Franklin Institute (J. Franklin Inst.)

Institute of Electrical Engineers (Physics Abstracts)

Pergamon Press (Chem. Eng. Sci.)

The Combustion Institute (Symposia on Combustion)

The American Chemical Society refused to grant permission to reproduce abstracts from any of their journals or from Chemical Abstracts, and the abstracts from these were omitted. Fortunately, there was only a total of some 50 references from all ACS sources; the Chemical Abstract reference number has been indicated in those case.

D. E. Blake
Chemical Engineer

C. E. Lapple
Senior Scientist

Approved:

Nevin K. Hiester
Director, Chemical Synthesis and
Research Division

Table I

ABSTRACT SOURCES REVIEWED FOR PRIMARY SURVEY

ABSTRACT SOURCE [Abbreviation used]	ISSUES REVIEWED	SUBJECT HEADINGS CHECKED		
Chemical Abstracts [CA-Volume No.-Abstract No.]	Jan., 1947 - Sept., 1964	Atomization Clouds Colloid Disperse Systems Drops	Dust Fog Fumes Mist Particles	Precipitation, electric Smoke Sprays Triboelectricity
Physics Abstracts: Science Abstracts, Section A [PA-Volume No.-Abstract No.]	Jan., 1926 - Dec., 1941	Colloids Dielectrics and Capacitance Electrostatics	Fusion and Solidification Meteorology	Surface Properties Terrestial Electricity and Magnetism
	Jan., 1942 - Sept., 1964	Aerosols Atmospheric Electricity Bibliographies Charge Colloids Condensation	Conferences Dielectric Phenomena Drops Electrets Electric Charge Electric Fields	Electrokinetic Effects Electrophoresis Electrostatics Liquids Zeta Potential
Battelle Technical Review (issued by Battelle Memorial Institute) [BMI-Volume No.-Abstract No.]	Jan., 1952 - Sept., 1964	Aerosols Colloids Electrophoresis Dust	Dust Control Drops Particles	Smoke Fumes Powders
Scientific and Technical Aerospace Reports (STAR) (issued by NASA) [N-Year-Abstract No., Issue No. Section No.]	Apr. 26, 1962-Sept., 1964	Section 07 (Chemistry) Section 23 (Physics, General) Aerosols	Colloids Dust Drops Particles, Charged	Particles Powders Smoke
Translation Monthly (issued by Special Libraries Association Translation Center) [TM-Volume No.-Page No.]*	Jan., 1948 - Dec., 1951	The following authors were checked: Arabadzhi, V. I. Aron, Ya. B. Avak'yants, G. M. Deryagin, B. V. Dukhin, S. S. Dunskiy, V. F. Evaldo, N.	Fuks, N. A. Herszderfer, S. Kitaev, A. V. Krajewski, J. Levin, L. M. Livenson, A. R. Makhotkin, L. G.	Martenelli, A. Muchnik, V. M. Natanson, G. L. Pudovkina, I. R. Sergiyeva, V. P. Solov'yev, V. A. Vigdorchik, Ye A.
Technical Translations (issued by the Dept. of Commerce, OTS) [T-Volume No.-Page No.]*	Jan., 1952 - Sept., 1964	Aerosol Atomization Charged Particles	Drops Fog Electric Fields	Electrostatics Particles (Airborne)

* In the "Technical Translations" and "Translation Monthly" abstracts the following abbreviations are used to indicate the source of the available translation described:

ATS
Associated Technical Services, Inc.
P. O. Box 271
East Orange, New Jersey

CB
Consultants Bureau Enterprises, Inc.
227 West 17th Street
New York, 11, New York

CSIRO
Commonwealth Scientific and Industrial Research Organization
Information Service
314 Albert Street
East Melbourne C. 2, Victoria
Australia

HB
Henry Brutcher
P. O. Box 157
Altadena, California

LC
Photoduplication Service
Publication Board Project
Library of Congress
Washington, 25, D.C.

NASA
National Aeronautics and Space Administration
1520 H Street, N.W.
Washington, 25, D.C.

NRCC
National Research Council, Library
Ottawa, 2, Canada

OTS
Office of Technical Services
Department of Commerce
Washington, 25, D.C.
(Also available through Department of Commerce Field Offices)

SLA (in Technical Translations)
R (in Translation Monthly)
SLA Translations Center
The John Crerar Library
86 East Randolph Street
Chicago, 1, Illinois

Table II

ADDITIONAL ABSTRACT SOURCES REVIEWED FOR SUPPLEMENTARY SURVEY

ABSTRACT SOURCE [Abbreviation Used]	ISSUES REVIEWED	SUBJECT HEADINGS CHECKED
"Spray Literature Abstracts", (Vol. I) compiled and edited by K. J. DeJuhasz. Published by ASME 1959 [deJ I-Page No.]	Entire Volume	Each Entry was Reviewed
"Spray Literature Abstracts, Vol. II," compiled and edited by K. J. DeJuhasz. Published by ASME, 1964. [deJ II-Page No.]	Entire Volume	Each Entry was Reviewed
International Aerospace Abstracts (issued by AIAA) [A-Year-Abstract No., Issue No.-Section No.]	Jan. 3, 1963 - May 23, 1965	Aerosols Atomization Colloid Propulsion Drops Dust Electrostatics Particles Sprays
Applied Mechanics Reviews (issued by ASME) [AMR-Vol. No - Abstract No.]	Jan., 1950 - May, 1965	Micromeritics Section Aerosols Atomization Combustion (fuel jets) Combustion (liquid drops) Drops Jets (incompressible flow) Sprays
Electrical Engineering Abstracts: Science Abstracts, Section B. [EA-Vol. No.-Abstract No.]	Jan., 1960 - Dec., 1964	Agriculture Corona Electrets Electrostatics Precipitation, electric Static Electricity

PRIMARY SURVEY

(Open literature references through September 30, 1964)

1. Anonymous

"Report of Symposium V. Aerosols." U.S. Dept. Commerce, OTS, PB 111411, 145 p. (June 1953).

2. Anonymous

"Static Electricity." Nat. Fire Protection Association (1950).

3. Anonymous

"Electrostatic Air Cleaning." Steel 115, No. 17, 86-88 (October 23, 1944).

4. Anonymous

"Electrical Precipitation." Mech. World 116, No. 3012, 311-331 (September 22, 1944).

5. Anonymous

"Trapping Dust Electrically." Westinghouse Engineer (May 1942).

6. Anonymous

"Dust Collection at Hams Hall Power Station." Ind. Chemist, 507-511 (December 1938).

7. Anonymous

"Suppression of Ink Misting," Battelle Tech. Review, 13, pp. 15 (July 1964). The following is the complete article.

Printing presses, particularly those used for printing newspapers, generate enough black mist from the ink rolls to produce dirty working conditions and even fire hazards. Despite intensive studies, the industry has been only partially successful in eliminating this nuisance.

As reported by Robert B. Reif, Lewis E. Walkup of Battelle, and C. W. Warner of Cutler-Hammer, Inc., before the recent annual Pittsburgh meeting of the Technical Association of the Graphic Arts, such a mist is formed at the exit side of two ink rolls running in contact. As the ink layer splits, fine threads of ink are pulled out. These threads can break and pull back into the ink film. However, some of them break at two points, and the isolated sections from drops that fly into the air.

In studies at Battelle and at Cutler-Hammer, Inc., an electrostatic method for suppressing ink mist was conceived whose basic principle involves electrically charging the mist particles and using electrical fields to drive them back onto the rolls. The small gravitational and centrifugal forces on the droplets are easily overcome by such electrical forces. In an electrical

field of 6000 volts per centimeter, the electrical force on a 200-micron particle can be 15 times that of gravitational forces, 150 times for a 20-micron particle. Therefore, the ink mist can be driven back to the roll.

Basically, the electrostatic unit for suppressing mist is simple—it consists of a single 0.10-inch stainless steel wire placed about one inch from the exit side of each nip in the inking train. However, a number of knotty practical problems had to be solved before commercial installations could be considered. Commercial equipment utilizing the electrostatic method for controlling this pressroom annoyance is now in use.

8. Anonymous

N64-20201 Joint Publications Research Service, Washington, D.C.
TURBULENT DIFFUSION IN THE SURFACE LAYER OF THE EARTH'S ATMOSPHERE
6 May 1964 321 p refs Transl. into ENGLISH of Tr. Leningr. Gidrometeorol. Inst. (Leningrad), no. 15, 1963 p 1-240 (JPRS-24480; OTS-64-21213) OTS: $5.00

CONTENTS:

N64-20201

9. Anonymous

MICROMETEOROLOGY, AEROSOLS, AND AIR POLLUTION: BIBLIOGRAPHY. 25 Apr 63 [16]p. 108 refs.
AID rept. B-63-50. AD-403 264
Order from OTS or SLA $1.60 63-19353

DESCRIPTORS: *Bibliographies, *Micrometeorology, *Aerosols, *Atmospheric pollution, Meteorology.

This bibliography is based on Soviet and Soviet-bloc open-source materials available at the Aerospace Information Division and the Library of Congress. The bibliography is divided into two parts: Part I. Micrometeorology and Part II. Aerosols and Air Pollution. Titles of monographs are given in transliterated form, followed by the English translation. Library of Congress call numbers are included at the end of an entry when the item is cataloged and available in the collections of the Library. The 108 entries are arranged alphabetically by author. An author index is provided.
T10-363

10. Anonymous

"Device Leads to Speedy Process for Encapsulating Tiny Particles."
Chem. Engr. 72, 66-7 (April 26, 1965).

11. Anonymous

"Electrostatic Flocking Makes Gains."
Chem. and Eng. News 43, No. 2, 41-2 (January 11, 1965).

A-1. Abonnenc, L.

1883. *Formation of Drops in an Electric Field.* **L. Abonnenc.** (Comptes Rendus, 182. pp. 1031–1033, April 26, 1926.)—The diminution in weight of drops formed at the extremity of a cylindrical tube, under the influence of variously disposed electric fields, is studied, and it is noted that its amount decreases with liquids more nearly approaching perfect dielectrics. It is concluded that the effects are not due to alteration by the electric field of the viscosity, or, in the case of insulating liquids, of the surface-tension, but are due to forces resulting from electric charges spread over the surface of the drop, and, to a less extent, to forces arising from the polarisation of the dielectric, comparable with those occurring during the formation of a drop in a magnetic field.

PA-29-1883

A-2. Ailam, G., and I. Gallily

11345 **STABILITY OF AN ELECTRICALLY CHARGED DROPLET. G.Ailam(Volmez) and I.Gallily.** *Phys. of Fluids* (USA), Vol. 5, No. 5, 575–82 (May, 1962).

The stability of an electrically charged droplet with respect to mechanical deformations is studied under the assumptions that the liquid is perfectly conducting, the medium devoid of external fields of force, and the sum of the electrical and mechanical energies in the system conserved. Unlike Rayleigh's case, which dealt with small perturbations of spherical drops, the deformations considered in the present case are allowed to be large in size but confined in shape to ellipsoids of revolution. The energy of the deformed droplet is expressed as a function of a geometrical parameter and the ratio α between the electrical and surface energies of the corresponding spherical shape. Likewise, the dependence of the extremal points on α is investigated. Conforming with Rayleigh, the spherical droplet is shown to be unstable for $\alpha > 4$ and stable for $\alpha < 4$. However, for a certain range of α in the latter case, it is found to be only in a metastable state. In addition, both one prolate and one oblate ellipsoid of minimal energy are shown to exist for every $\alpha > 4$

PA-65-11345

A-3. Allan, R. S., and S. G. Mason

"Particle Behaviour in Shear and Electric Fields. I-Deformation and Burst of Fluid Drops." Proc. Roy. Soc., A267, No. 1, 45-61 (April 24, 1962).

The deformation and burst of liquid drops suspended in liquid dielectrics in an electric field were measured. At low electrical fields, the deformation of conducting drops into prolate spheroids showed good quantitative agreement with theoretical equations based on electrostatic theory. Dielectric drops exhibited appreciable deviation from the theory, especially in a number of systems when oblate spheroids were formed. The mode of electrical burst was found to show considerable variation with the electrical properties of the systems.

The deformation, orientation and burst under the combined action of shear and electric fields were also studied and found to agree with a theory based upon a superposition of electric- and shear-deformation forces. The mode of break-up was found to depend on the ratio of the velocity gradient to the electric field strength, on the interfacial tension, and on the ratios of dielectric constants and of viscosities of the two liquids.

Author

A-4. Allan, R. S., and S. G. Mason

"Particle Behaviour in Shear and Electric Fields. II-Rigid Rods and Spherical Doublets." Proc. Roy. Soc., A267, No. 1, 62-76 (April 24, 1962).

The rotation and orientation of rigid conducting rods suspended in a dielectric liquid in combined shear and electric fields were studied. Excellent agreement with predictions based on a theoretical analysis of this problem by Demetriades was obtained. The approach of rigid conducting spheres in an electric field due to electrostatic attractive forces was studied and found to be in accord with theory.

Collisions of rigid conducting spheres in shear and electric fields were also investigated. It was found that in many cases, permanent doublets could be formed as a result of particle adhesion. The technique affords a sensitive method of measuring adhesion forces.

Author

A-5. Alty, T.

233. *Origin of the Electrical Charge on Small Particles in Water.* **T. Alty.** (Roy. Soc., Proc. 112. pp. 235–251, Aug. 3, 1926.)—In continuation of earlier work [Abstract 242 (1925)], the electrical charge on an air bubble in water is measured under various conditions, and an examination is made of the mode of formation of this surface charge. For bubbles ranging in diameter from 2·0 to 0·2 mm. the total charge is independent of the diameter when equilibrium conditions obtain at the surface. The constitution of the surface layer is examined theoretically, and a new method of measuring the potential difference between the surface and the interior of the liquid is suggested.

PA 30-233

A-6. Anderson, E.

4472. Electric Wind in Electrical Precipitation in Gases. E. Anderson. *Physics*, 3. *pp.* 23–28, *July*, 1932.—It is at present a moot point what is the rôle played by the electric wind in the electric precipitation process. On the one hand it is held that the electric wind, through its effect on the motion of the particles towards the collecting electrode is the determining factor in the process, while on the other side it is argued that the net action of the wind is unidirectional and that its chief rôle is to promote uniform distribution of the particles in the gas. The electrical precipitation process consists in the "ionisation" of suspended material particles through adhering gas ions, and the consequent motion of these ionised particles to the collecting electrode under the action of the electric field. The author, studying the complex stream of moving ions and gas molecules in a point-to-plate precipitation, concludes that with conducting particles the total rate of precipitation may be determined as much by the rate of ionisation as by the rate of transmission, while with relatively non-conducting particles that tend to hold their charges the rate of deionisation at the electrode is the determining factor. When the transportation or ionisation rate is a determining factor, these being affected by the electric wind, the electric wind affects the precipitation-rate; where the rate of deionisation is the determining factor, the electric wind can have no direct effect on the precipitation rate.

PA-35-4472

A-7. Arabadzhi, V. I.

Arabadzhi, V. I.
KINETICS OF THE COLLISION OF DROPS. [1959]
2p. (3 figs. omitted).
Order from LC or SLA mi$1.80, ph$1.80 59-17159

Trans. of Meteorologiya i Gidrologiya (USSR) 1956, no. 4, p. 35-36.

An analysis of motion pictures (at 1500 frames/sec) of the collision of 2 mutally perpendicular streams of 2- to 6-mm diam drops having an outflow velocity of about 2 m/sec and directed respectively toward the ground and horizontally indicated that on collision an annular water belt is formed which undergoes a gradual disintegration. Motion pictures of the fall of drops on a plane water surface showed that the latter breaks and is bent downward, then water is ejected upwards which sometimes terminates at its summit by a fairly symmetrical bubble. After the ejection recedes there may occur a second small ejection. The ejections are caused by brief damped oscillations of the water surface caused by the impact of the drop. By using colored drops it was ascertained that a vortical ring of the substance of the impacting drop moves out and penetrates several centimeters of the body of the liquid. The motion picture recordings of the fall of drops upon a water surface show that the bubbles are formed at the summit of the ejection of water or, less frequently, at the lateral projections thereof. This confirms the theory of the hallo-electric affect of Leonard-Frenkel according to which electrification of liquids on their spattering takes place by a drawing of the charge from the double layer extending to a certain depth into the liquid.

T2-524

A-8. Arabadzhi, V. I.

5834. ON SOME ELECTRICAL PROPERTIES OF WATER AND ICE. V.I.Arabadzhi.

Zh. éksper. teor. Fiz., Vol. 30, No. 1, 193-5 (1956). In Russian.

These properties are important in studying atmospheric electricity. Four experiments are described: (A) Positive charges obtained on ice when it is sawn or scratched. They are or order 10^{-9} coulomb per gramme of ice and depend on its temperature. (B) E.m.f. of ice polarization after the application of a direct voltage for one hour to it. It was roughly equal to 3 volts for every volt per cm applied. (C) Contact potential between water and ice was measured with a radio-thorium collector. The average result was 1.5 volts. (D) The potential difference, produced in a jet of steam and water droplets at different pressures as a function of the distance from an orifice, showed a maximum of up to 3 kV/m for 6 atm at a distance of 10 m.

PA-59-5834

A-9. Arabadzhi, V. I.

R-29. Electrification of particles in clouds. Meteorologiya i gidrologiya, No. 6, p. 37 (November-December 1955).

TM 3-4

A-10. Arabadzhi, V. I.

"The Electrification of Liquids by Atomization," Kolloidnyi Zhur 11, 209-10 (1949).

A-11. Archbold, J. W.

Preliminary note on condensation in the form of clouds and dew. ARCHBOLD, J. W. *Phil. Mag.*, 34, *pp.* 632-642, *Sept.*, 1943.—The author uses classical statistical mechanics to assess the distribution of water drops according to size and to exhibit the competition for growth amongst an assemblage of drops. Gravity has a negligible effect. If there are no electric charges, condensation occurs in large drops, with no cloud. In the presence of charges, the size distribution depends on the charge distribution: if all the drops are similarly charged, condensation still takes place in large drops, but these are accompanied by a cloud of fine drops which is perhaps visible. Ordinary cloud formation is associated with temperature variations and departure from equilibrium conditions. Similar conclusions are reached for dew formation, though here the degree of affinity of water for the bedewed surface is important.

PA 46-2803

A-12. Arendt, P., and H. Kallmann. Trans. available from SLA

1083. *The Mechanism of the Electrification of Small Particles in Clouds.* **P. Arendt** and **H. Kallmann.** (Zeits. f. Physik, 35. 6. pp. 421-441, 1926.)—The mechanism of the electrification of small particles in clouds, fogs, mists, etc., is shown experimentally to be a process of diffusion. [See also Abstract 2356 (1923).]

PA 29-1083

13. Aron, Ya. B., and M. V. Pavlova

Aron, Ya. B. and Pavlova, M. V.
CAPILLARY PHENOMENA IN DROPS (Kapilliyarnyye Yavleniya v Kaplyakh). Feb 61 [11]p. 7 refs. RTS 1776. Order from LC or SLA mf$2.40, ph$3.30 61-19104

Trans. of Zhurnal Fizicheskoy Khimii (USSR) 1948, v. 22, no. 10, p. 1251-1255.

A study was made of the variation of the wetting angle of water on paraffin wax with drop size, inclination of the wax surface, and deformation of the drop. The results are considered in the light of the physical mechanism of adhesion of drops to a solid surface. The rolling of drops down an inclined surface is also discussed. The influence of electrical potential differences on the contact angle was demonstrated for the case of mercury, but not for solid metallic surfaces. The observed changes in contact angle and the qualitative picture of the deformation of drops on compression, evaporation, and inclination of the surface, indicate the existence of a definite equilibrium value of the contact angle and of its indubitable reversibility. T5-667

A-14. Arridge, R. G. C.

7056 CONTACT ELECTRIFICATION AND POLARIZATION OF NYLON THREADS. R.G.C.Arridge.
Brit. J. appl. Phys., Vol. 11, No. 5, 202-5 (May, 1960).
A study has been made at different relative humidities of the way in which electric charges on nylon threads decay. For relative humidities of less than about 35%, the charges remain localized and decay in magnitude at very nearly an exponential rate. For relative humidities greater than 35% the charges spread out along the thread and the decay of peak charge with time can be approximately represented by a $t^{-1/2}$ law rather than by an exponential one. If a diffusion equation of the type $\rho = At^{-1/2} \exp(-\chi^2/4Dt)$ is applied to the latter results, values of the diffusion constant D are obtained which are independent, within the accuracy of the experiment, of (i) the sign of charge and (ii) whether it was a contact charge or a polarization charge. D varies exponentially with relative humidity.

PA-63-7056

A-15. Arshinov, A. A., and A. K. Musin

8064. EQUILIBRIUM IONIZATION OF PARTICLES. A.A.Arshinov and A.K.Musin.
Dokl. Akad. Nauk SSSR, Vol. 120, No. 4, 767-80 (1958). In Russian.
General solution of the problem of equilibrium ionization of particles is derived. The solution covers all cases from multiple ionization of atoms to ionization of macroscopic particles.

PA 61-8064

A-16. Arshinov, A. A., and A. K. Musin

Trans. in Soviet Physics, Doklady, 3, No. 5, 99-101 (1958).

4094. THERMAL EMISSION OF ELECTRONS FROM CARBON PARTICLES. A.A.Arshinov and A.K.Musin.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 3, 461-3 (1958). In Russian.
Derives formulae for the calculation of concentration of electrons in carbon flames. The derivation is based on the Richardson—Dushman equation, taking into account recombination of electrons with positively charged carbon particles. Electron work function of 6.8 eV was calculated for carbon particles at temperatures between 3100 and 3300°K, using above formulae and the experimental values of electron concentrations in acetylene—oxygen flames given by Shuler and Weber (Abstr. 4651/1954). It is shown that the observed concentritions are due to carbon particles of radius of the order of 10^{-6} cm. PA 61-4094

A-17. Ashcraft, T. L.; J. Riney, and N. Hackerman

"Electrostatic Voltmeter for the Measurement of Surface Potentials," Rev. Sci. Instr 34, No. 1, 5-7 (1963).

The apparatus contains a reference surface (gold) and provision for evaporating the experimental surface onto a rotating metal plate. Circuits used to measure the surface potential difference between the two metal surfaces are described. The apparatus has a rapid and continuous response to changes in the surface potential difference (SPD) between an experimental and a reference surface. As a result, the resolution of the initial variation of the SPD on sorption of oxygen on evaporated iron has been materially increased. The apparatus can be modified to allow SPD measurement on single crystals or catalyst surfaces.

Author

A-18. AEC

"Handbook on Aerosols," Washington D.C. (1950).

A-19. Avak'yants, G. M.

Avak'yants, G. M.
THEORY OF ELECTRON EMISSION FROM METALS IN ELECTRIC FIELDS, tr. by L. B. Leder. May 61 [19]p. 7 refs.
Order from OTS or SLA $1.60 61-23826

Trans. of Akad[emiya] Nauk Uzbek[skoi] SSR [Tashkent] Fiz[iko]-Tekh[nicheskii] Inst[itut]. Trudy, 1955, v. 6, p. 43ff.

DESCRIPTORS: *Electric fields, *Field emission, Theory, Metals, Thermionic emission, Penetration, Intensity.

Calculations show that in the range of field intensity from 10^7 v/cm to 10^8 v/cm there is noticeable penetration of an electric field into the metal. In the case

of field emission the field penetration leads to an apparent decrease in the work function (ϕ) by $2eEL$. In the case of thermionic emission, the field penetration leads to an apparent decrease of the work function half that of field emission. Within the framework of the Tamm-Blokhintsev theory the action of an external electric field noticeably changes the true work function, and, in particular, the true work function is increased by eEL. Thus, the region of field intensity from 10^7 to 10^8 v/cm does not appear to be a region of unrestricted use. However, for $eEL \ll \phi$ ln i, as a function of E^{-1}, a straight line is described with a slope which depends only on ϕ but not on ϕ^2. Even then the value of the emission current may noticeably change.

T6-705

A-20. Avak'yants, G. M.

AVAK'YANTS, G. M.

ATS-RJ543. The theory of transport equations in strong electric fields. Part I. Zhur. Ekspl. i. Teoret. Fiz., 26, no.5, p.562-575, 1954. (8p.)

$14.80.

ATS-RJ544. On the theory of the transport equations in strong electric fields. Part II. Zhur. Ekspt. i. Teoret. Fiz., 26, no.6, p.668-697, 1954. (14p.)

TM 4-91

A-21. Avy, A P.

"Les Aerosols," Dunod, Paris, 292 pp. (1956).

B-1. Baimakov, Iu. V.

"Improvement of Electric Filters for Dust Collection" (in Russian), Elektrichestro No. 3, 60-6 (March 1947).

B-2. Banerji, S. K.

"On the Interchange of Electricity Between Solids, Liquids, and Gases in Mechanical Actions," J. Indian Phys., 12, 409-36 (1938).

B-3. Banerji, S. K.,and S. R. Lele

9248. Electric charges of rain-drops. S. K. BANERJI AND S. R. LELE. *Proc. Nat. Inst. Sci. India.*, 18, 93–124 (*March–April*, 1952).

The recording equipment described includes a Wilson tilt electroscope for recording the charge on individual rain drops. A Simpson apparatus giving the charge on rain collected every 2 min and an ionium collector for continuous recording of the earth's electric field were kept in simultaneous operation. A number of specimen records obtained during and in the absence of thundery conditions are reproduced and the data obtained in 1931–32 in Bombay and in 1935–36 in Poona are tabulated. Both pos. and neg. charges are found to be present on rain drops from any part of the cloud. The mean charge of pos. drops is 0·021 e.s.u. in non-thunderstorm rain and 0·051 in thunderstorm rain, the equivalent mean charges of neg. drops being 0·023 and 0·057 e.s.u. respectively. It is shown that, initially, cloud particles develop charge in the same way as colloidal particles or particles floating in a medium and capturing ions. These initial charges are augmented by the Simpson process of the break-up of rain drops. At heights above the freezing level the collision of ice particles is believed to make these negatively charged.

PA 55-9248

B-4. Barret, P.

3796. CONTRIBUTION TO THE STUDY OF ELECTROLYSIS BY SPARK. THE CATHODIC ATOMIZATION OF ELECTROLYTES. P.Barret.
Bull. Soc. Chim. France, 1956, No. 8-9, 1243-53 (July-Aug.). In French.

An account of a phenomenon observed in the course of an investigation into the production of aerosols using electrical discharges. The phenomenon is the formation of droplets on a platinum wire cathode suspended over the surface of ionized liquids and the atomization of these to form aerosols. A brief description of the apparatus and results obtained is given. A detailed discussion interprets the results and gives a theory of the mechanism of the phenomenon.

PA 60-3796

CA 50-15284i

B-5. Beard, W. C., Jr.

"Powder Aerosols," Soap and Chemical Specialties, 31, pp. 139, 141, 169 (January 1955).

B-6. Beaver, C. E.

"Cottrell Electrical Precipitation Equipment, Some Technical and Engineering Features, Recent Developments and Application in the Chemical Field," AlChe Trans 42, No. 2, 251-261 (April 25, 1946).

B-7. Becker, A., and I. Schaper

244. Ice electricity. A. BECKER AND I. SCHAPER. *Z. Naturforsch.*, 4a, 194–8 (*June*, 1949) *In German.*

The fusion of ice in an electrical field is accompanied by the appearance of electrical charges which are conveyed by charged particles into the surrounding atmosphere. Full experimental details are included in the paper for this new electrical effect.

PA-53 244

B-8. Beischer, D.

"Electrical Properties of Aerosols," Z. Ver. deut. Ing., Beiheft Verfahrenstech, pp. 90-93 (1937).

B-9. Bell, G. M.; S. Levine, and B. A. Pethica

17429 THE SURFACE PRESSURE OF IONIZED MONOLAYERS. G.M.Bell, S.Levine and B.A.Pethica.
Trans Faraday Soc. (GB), Vol. 58, Pt 5, 904-17 (May, 1962).
It is shown that the commonly accepted relation

$$\Delta\Pi = \int_0^{\phi_0} \sigma d\phi$$

for the increase in surface pressure resulting from the charging of a monolayer is not general. The surface pressure increase also includes a term relating to the change of the "non-electrostatic" contribution to the surface free energy. An important part of this additional term originates in the fluctuation or "self-atmosphere" electrostatic potential at an ion in the monolayer and may also be described as the "discreteness-of-charge contribution. The use of two-dimensional equations of state for ionized films as a way of investigating the properties of the ionic double layer is briefly considered. PA-65-17429

B-10. Beller, W.

"New Inertial Sensors Show Promise," Missiles and Rockets 14, No. 26, 32-33 (June 29, 1964).

B-11. Belyaeva, I. I., A. E. Mikirov, and N. S. Smirnov

Effect of the ionization of air on the disperse phase of aerocolloids. I. I. Belyaeva, A. E. Mikirov, and N. S. Smirnov. *Colloid J.* (U.S.S.R.) 19, 25-7(1957)(English translation).

CA-52-8682d

B-12. Benton, D. P., and G. A. H. Elton

"Droplet Interaction in Aqueous-Disperse Aerosols," in "The Physical Chemistry of Aerosols," Disc. Far. Soc. No. 30, pp. 68-71 (1960).

Experimental evidence is given to show that the collection efficiencies of droplets in an aqueous aerosol are a function of the electrolyte concentration. A semi-quantitative indication is given of the influence of the Dukhin-Derjaguin diffusional electrokinetic effect on collection efficiencies of droplets of diameter approximately 3 μ. A fully quantitative test of the theory of Dukhin and Deriaguin must await further experiments' data.
Author

B-13. Benton, D. P., and G. A. H. Elton

"The Stability of Aqueous-Disperse Aerosols," in "Electrical Phenomena and Solid/Liquid Interface," Butterworths, London, Proc. Second Int. Congress of Surface Activity, pp. 587-593 (1957).

Author

B-14. Berg, T. G. O., and N. Brunetz

"Behavior of Charged Particles on Glass Slides," Arch. Environ. Health 5, No. 1, pp. 16-20 (July 1964)

B-15. Berg, T. G. O.; G. C. Fernish, and W. J. Flood

"Charge Analyzer for Aerosols and Spray," Rev. Sci. Inst. 35, No. 6, 719-723 (June 1964).

A charge analyzer is described that permits the rapid and convenient charge analysis of aerosols and sprays emerging from a nozzle at a high flow velocity. The charged particles are deposited on two collector electrodes. The rate of charge deposition is measured by means of a recording voltmeter, one for each electrode. The amount of material deposited is determined by weighing on a microbalance. Measurements have been conducted with several materials at flow rates between 1.5 and 15 m/sec. Such data are presented.
Author

B-16. Berg, T. G. O., G. C. Fernish, and T. A. Gaukler

14131 THE MECHANISM OF COALESCENCE OF LIQUID DROPS.
T.G.Owe Berg, G.C.Fernish and T.A.Gaukler.
J. atmos. Sci. (USA), Vol. 20, No. 2, 153-8 (March, 1963).
The coalescence of two liquid drops, pressed against each other while a voltage is applied across the drops, was studied with high-speed photography. The delay between contact and coalescence is of the order of milliseconds for distilled water, alcohols, and aqueous solutions of hydrochloric acid. The inverted value of this time, the rate of coalescence, is proportional to the

voltage between the drops at low voltages and to the square of the voltage at high voltages. In both cases, the plot of rate against voltage extrapolates to zero rate at zero voltage. In the linear case the rate is proportional to $(\epsilon-1)^{1/2}$, in the parabolic case to ϵ, where ϵ is the dielectric constant. The following interpretation of the data is offered: coalescence is effected by formation of bonds across the interface between the drops. This may occur in two ways, by breaking of bonds and formation of new bonds, or by gradual rearrangement of bonds. In the former case, the rate if proportional to the energy in the drops and thereby to ϵ and the square of the voltage. In the latter case, the rate is proportional to $(\epsilon-1)^{1/2}$ and the voltage.

PA 66-14131

B-17. Berg, T. G. O., Fernish, G. C., and Hunkins, M. J.

"Electrostatic Charges on Men and Women in Various Clothing," Arch. Envir. Health, 7, 217-228 (August 1963).

B-18. Bewig, K. W., and W. A. Eisman

"Surface Potentials and Induced Polarization in Nonpolar Liquids Adsorbed on Metals," J. Phys. Chem. 68, No. 7, 1804-14 (July 1964).

Recently, we reported that the contact potential difference between a metal and a suitably coated metal serving as a reference electrode could be used in clean air as a sensitive and reliable tool for studying adsorbed monomolecular films of polar compounds. This reports results of the study of the change (ΔV) in the contact potential difference resulting from the adsorption on a metal of a film of each of the following pure nonpolar liquid compounds: hexane, octane, etc., through hexadecane, cyclohexane, dicyclohexyl, benzene, toluene, xylene, and carbon tetrachloride. Clean polished surfaces of Pt, Au, Ag, Cu, Ni, W, Cr, Sn, and Cd were the adsorbing metals. No attempt was made to avoid surface oxidation after polishing. Contact angles of water, glycerol, methylene iodide, and hexadecane on the same adsorbed films supplied information about their nature, packing, and orientation. The following conclusions were made: (i) evaporation of the liquid always leaves on the metal an adsorbed monolayer oriented so that the maximum number of atoms contact the surface; (ii) when excess liquid is wiped off the metal by rubbing with clean filter papers, a monomolecular adsorbed film remains whose properties are identical with those obtained by evaporation; (iii) the electrostatic image field of the adsorbed molecule is not sufficient to cause the observed values of ΔV, and the parameters involved include the lattice spacing and atomic volume of the metal. Values of ΔV obtained were reproducible and characteristic for each compound and metal. Theoretical calculations of ΔV in terms of the molecular polarization induced in the adsorbed liquid molecules by the electrostatic field just outside of the surface of the metal agreed in order of magnitude with experimental data. As theory predicted, ΔV for any compound increased linearly with the electrostatic field intensity in the vicinity of the adsorbed molecules, or with the total energy necessary to extract a conduction electron from the metal.

Author

B-19. Biancani, H.; E. Biancani, and A. J. R. Godefroy

Separation of charged particles. Hugo Biancani, Elio Biancani, and Alain J. R. Godefroy. Fr. 985,808, July 24, 1951.

CA-49-10772c

B-20. Bierman, A.

"An Application of the Poisson-Boltzmann Equation to Nonidentical, Charged Particles," Proc. Nat. Acad. Sci. 41, 245 (1955).

B-21. Bierman, A.

"Electrostatic Forces Between Nonidentical Colloidal Particles," J. Colloid Sci 10, No. 3, 231 (1955).

The Verwey-Overbeek theory is extended to nonidentical particles and shown to be in need of revision. This revision is carried through by introducing an interaction dependent ψ_0. It is shown that attractive forces can arise between nonidentical plates at small distances. The conditions for this attraction and the range of this force are calculated. It is shown that the range can be as large as a few hundred Angstroms.

Author

B-22. Bisa, K.

Spatial density of electrical charges in dispersion aerosols. Karl Bisa. *Z. Aerosol-Forsch. u.-Therap.* 5, 288-303(1956).

CA 51-3235b

B-23. Bisa, K.

"Stabilization of Aerosols by Means of Electrets," Z. Aerosol-Forsch u. Therap 3, 504-509 (1954).

B-24. Bisa, R.

"On the Biological Importance of Electroaerosols and a Method for the Preparation," Z. f. Aerosol-Forsch. u. Ther. 1-2, 286 (1952-3).

Um bei der Raumbehalation beständig, nicht zu schnell absinkende Aerosole zu erhalten, hat man zu dem Kunstgriff einer zusätzlichen elektrischen Aufladung gegriffen und deshalb von der Elektrizität als einem notwendigen Übel gesprochen. „Übel" soll dabei wohl soviel bedeuten wie erschwerte Durchführbarkeit der therapeutischen Maßnahmen durch zusätzliche, z.T. auch bizarre elektrische Wirkungen. Leider ist es so, daß wir seit 223 Jahren zwar qualitativ vom Vorhandensein elektro-biologischer Wirkungen wissen, sie aber bis heute noch nicht in allen Stücken quantitativ erfassen können. Um diese nun zu erkennen und in zielstrebiger Weise mit den Aerosol-Wirkungen zu kombinieren, werden Anlagen benötigt, die wie die hier beschriebene die Wirkungen der Elektrizität und der Aerosole auch getrennt zu beobachten gestatten.

Author

B-25. Blanchard, D. C.

4140. ELECTRICALLY CHARGED DROPS FROM BUBBLES IN SEA WATER AND THEIR METEOROLOGICAL SIGNIFICANCE. D.C.Blanchard.
J. Meteorol., Vol. 15, No. 4, 383-96 (Aug., 1958).

A modification of Millikan's oil-drop experiment was used to determine the electric charge and radius of drops that were ejected from a bursting bubble at an air-sea water interface. Charge measurements were made of both the natural and the induced charge. Drops of 2 to 25 μ in radius carry natural charges of at least 2×10^3 to 5×10^5 e.s.u., respectively. The induced charges are considerably higher, reaching 10^6 elementary units on drops of 50 μ radius. The sign of the natural charge is positive on drops < 4 μ. For larger drops both the sign and magnitude of the charge appear to be a function of the depth of water through which the bubble rises. The meteorological significance stems from the fact that rain and snow, as well as whitecaps, can produce great numbers of small bubbles in the surface waters of the oceans. Both laboratory and field work suggest that the majority of these bubbles produce positively charged drops that contribute to the atmospheric space-charge. Of special significance is the fact that, for positive induction fields less than about 25 V/cm, a positive charge is found on the small drops. For fields greater than 25 V/cm the induced negative-charge exceeds the natural positive-charge and so the drops carry a net negative-charge. Consequently, small bubbles breaking at the surface of the sea in the presence of the earth's fair-weather positive field of about 1 V/cm will produce drops that carry a positive charge. Calculations based on measurements of the bubble spectrum produced by whitecaps indicate that the charge on the drops may, under some conditions, provide a counter-current of the same order of magnitude as the fair-weather conduction current. Thus the sea may be a source as well as a sink for the charge that maintains the earth's positive electric-field.

PA-62-4149

B-26. Bodenstedt, E.

269. Electrical charging in turbulent dust clouds. E. BODENSTEDT. *Z. angew. Phys.*, 6, *No.* 7, 297–303 (*July*, 1954) In German.

Describes a method for measuring the quantity and sign of charge associated with different types of dust of various particle sizes. Statistical analysis shows that the danger of self-excited dust explosions is greatest with dust of small particle size.

PA-52-269

B-27. Boehme, D. D., and H. Rabenhorst

"Adhesion Measurements Involving Small Particles," Trans. Inst. Chem. Eng. 40, 252-259 (1962).

B-28. Böer, K. W., and U. Kümmel

3498. ON THE ELECTROSTATIC CHARGING OF CdS SINGLE CRYSTALS UNDER THE ACTION OF HIGH ELECTRIC FIELDS. K.W.Böer and U.Kümmel.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 5-6, 217-24 (1958).
In German.

Both positive and negative charge accumulations were observed in crystals after a high current was passed through them. The dependence of this charge on the magnitude of the field and the frequency when a.c. fields were used (both in the dark and with weak illumination) and its independence of the nature of the electrode materials, can all be explained on the basis of a non-homogeneous bulk conductivity which also gives rise to dielectric (polarisation) after effects. It is argued that the conduction process at high fields cannot be explained in terms of space-charge limited currents initiated by electron injection from the cathode as stated by Rose and Smith (Abstr. 4646/1955).

PA-61-3498

B-29. Bogdanov, V. S.

Dispersion and electrical properties of aerosols formed during the radiolysis of gaseous hydrocarbons. V. S. Bogdanov. *Izv. Akad. Nauk SSSR, Otd. Khim. Nauk* 1961, 1520–2; cf. *CA* 56, 9609*f*.

CA-58-1077c

B-30. Bogoslowsky, E.

411. Surface Tension and Electric Charge. E. Bogoslowsky. *Ann. d. Physik*, 84. 2. *pp.* 323–326, *Oct.* 4, 1927.

Comments are made on certain errors in the calculations and observations of Ruff, Niese, and Thomas on charged drops in electric fields. [See Abstracts 2114, 2115 and 2116 (1927).]

PA-31-411

B-31. Böhm, J.

"Electric Dust Precipitation," Elektrotechnicky Obzor 37 No.17-18, 334-9 (September 27, 1948).

B-32. Böning, P.

410. Dust Electricity. P. Böning. *Zeitschr. f. tech. Phys.* 8. 10. pp. 305-308, 1927.

The appearance of free electric charges in matter in a finely divided state in gases may be traced, according to many observations and the researches arranged by the author himself, to two occurrences which have an underlying causal connection with the observed facts: these are collision and disintegration. Similar causes are found in the case of electricity developed by friction. PA-31-410

B-33. Boulloud, A.

6933. CALCULATION OF THE ELECTROSTATIC FORCE TENDING TO RAISE A CONDUCTING SPHERE FROM A CONDUCTING PLANE. A.Boulloud.
C.R. Acad. Sci. (Paris), Vol. 246, No. 24, 3325-8 (June 18, 1958). In French.

An inversion is used on the equivalent system of two contiguous spheres and the charge carried by the sphere is calculated using image theory. The force is deduced by considering the sum of the forces due to the external field and the image-charges on the other sphere, which is equivalent to the plane. PA-61-6933

B-34. Bourot, J. M.; R. Brun and B. Morillon

7677. The electrification of metal dusts. A. R. Boyle and F. J. Llewellyn. *J. Soc. Chem. Ind., Lond.*, 69, 45-9 (Feb., 1950).

The static electrification of a number of metal dusts (Al, Fe-Mn, Mg, Si, Zn) has been measured in two standard experiments. These results, together with the electrostatic energy required for the ignition of dust clouds of metal powders, provide a basis for the estimation of the electrostatic hazard likely to be encountered in handling quantities of materials. PA 63-10360

B-35. Boyle, A. R., and F. J. Llewellyn

10360 ACTION OF A UNIFORM ELECTROSTATIC FIELD UPON THE ORIENTATION OF ALUMINIUM FLAKES WHICH ARE SUSPENDED IN A GAS.
J.M.Bourot, R.Brun and B.Morillon.
C.R.Acad. Sci. (Paris), Vol. 250, No. 12, 2118-20 (March 21, 1960). In French.

A uniform electrostatic field of the order of 1000 V/cm can be applied to orientate aluminium flakes suspended in an air stream so as to counteract any flow orientation of the particles.

PA-53-7677

B-36. Brasefield, C. J.

19591 ELECTRIFICATION OF CARBON BLACK BY CONTACT WITH A METAL SURFACE.
C.J.Brasefield.
J. Franklin Inst., Vol. 270, No. 4, 283-90 (Oct., 1960).

A measured quantity of carbon black was allowed to slide down a steep surface of nickel (presumably oxidized) which was electrically grounded and the charge acquired by the carbon black was determined. Blacks were selected whose oxygen content varied from 0.4 to 11.6 per cent. It was found that a black of low oxygen content acquired a large positive charge and the the charge decreased with increasing oxygen content, becoming zero for 4 per cent oxygen and negative for larger oxygen contents. It thus appears that the electron affinity of carbon black increases with increasing oxygen content of the black. The positive charge acquired by a black of low oxygen content was found to decrease as the black was heated to higher temperatures, presumably because of increasing oxygen content of the black. The oxidation of certain blacks is not permanent if the temperature reaches only 400°C but is permanent if it reaches 600°C. The oxygen content at a particular temperature ceases to increase after the first 30 sec at that temperature. The oxidized surface of carbon black which is responsible for its high electron affinity cannot be produced by prolonged exposure of a black to atmospheres of CO, CO_2, or C_3O_2. Cigarette smoke is usually negatively charged, but if the cigarette is heated to 300°C, the smoke is positively charged, as though the electron affinity of the tobacco had been increased by oxidation. PA-63-19591

B-37. Bredov, M. M., and I. Z. Kshemyanskaya

3966. THE ELECTRICITY OBSERVED AFTER CONTACT BETWEEN TWO BODIES. M.M.Bredov and I.Z.Kshemyanskaya.
Zh. tekh. Fiz., Vol. 27, No. 5, 921-8 (1957). In Russian.

Measurements are reported of the charge observed on separating two surfaces in contact. The charge increases rapidly with speed of separation. In the case of two metals in contact, the measured charge is proportional to the difference between the work functions of the surfaces. In the case of contact of a metal with a semiconductor, the charge depends also on the free-carrier concentration in the semiconductor and on its dielectric constant. PA-61-3966

B-38. Briscoe, H. V. A., et al.

1487. *Electrostatic Charge on Glass Floats in Very Dry Liquids.* **H. V. A. Briscoe, P. L. Robinson** and **H. C. Smith.** (Phil. Mag. 3. pp. 63–64, Jan., 1927.)—During a series of tests on CCl_4 and BCl_3 to determine the density and thermal expansion by observations of flotation temperatures of calibrated glass floats, it was noticed that the floats became positively charged, if the liquid were agitated. The charge was probably due to friction between the liquid and the glass. The tendency to acquire the charge and the time required to dissipate it decrease with lapse of time, due probably to increased conductivity of the liquid. The effect was greater for CCl_4 than for BCl_3. PA-30-1487

B-39. Browning, J.

"Production and Measurement of Single Drops, Sprays, and Solid Suspensions," Advances in Chem. Series No. 20, 136-154 (1958). Pub. by Am. Chem. Soc.

Experimental methods presented in the literature may prove of value in combustion studies of both solid and liquid suspensions. Such suspensions include the common liquid spray. Uniform droplets can be produced by aerosol generators, spinning disks, vibrating capillary tubes, and other techniques. Mechanical, physicochemical, optical, and electrical means are available for determination of droplet size and distribution. The size distribution, aggregation, and electrical properties of suspended particles are discussed as well as their flow and metering characteristics. The study of continuous fuel sprays includes both analytical and experimental procedures. Rayleigh's work on liquid jet breakup is reviewed and its subsequent verification and limitations are shown. Author

B-40. Bühl, A.

4470. Waterfall Effect and the Surface Structure of Liquids. A. Bühl. *Kolloid Zeits.* **59.** *pp.* **346–353,** *June,* **1932.**—An atomising apparatus is described for the study of the waterfall (electrically-atomised-water) effect. When various gases are used it is found that the gas atmosphere (*e.g.*, with H_2, CH_4, N_2, CO, air, O_2) does not influence the main result and that atomisation *in vacuo* gives an exceedingly strong electrical effect. The mobilities of the electrical carriers are found to vary over a wide range. The purity of the water greatly affects the electrical yield, electrolytes entirely inhibiting the effect in some cases; experiments are recorded of the atomisation of dilute solutions of the LiOH and KOH and of HCl, LiCl, NaCl and KCl. In the case of colloids, the degree of dispersivity of the sol is of profound influence. The investigation has been extended to other liquids, *viz.*, benzene, hexane, xylene, ethyl ether, acetone, methyl and ethyl alcohols and nitrobenzene, when it was found that only those with a dipole moment gave the waterfall effect. Pure mercury and also the liquid amalgams give the effect, in the case of the former positive carriers being first formed and later negative ones. A Bibliography completes the paper.** PA 35-4470

B-41. Bühl, A.

1949. Electric Effect of Water Jets in Vacuum. A. Bühl. *Ann. d. Physik,* **3. 7.** *pp.* **978–992,** *Dec.* **18, 1929.**

An experimental investigation was made of the electrical effects obtained with jets of water impinging on an insulated metal disc in an evacuated chamber. The first simple apparatus used only established the existence of negative carriers, but further experiments with an improved type of apparatus, using a very fine jet, showed the existence of both positive and negative carriers, the latter being apparently more numerous than the former. With higher vapour pressures the ratio of negative to positive carriers is greater than at lower pressures. The results generally show that the breaking up into drops of a water jet in vacuum produces electrification which is connected with the withdrawal of electrical carriers from the water surface. The results are briefly discussed.

PA 33-1949

B-42. Bulgin, D.

3432. Static electricity on rubber-tyred vehicles. D. BULGIN. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 83–S 86 (1953).

The electrostatic charge which originates at the separation of the tyre tread from the road raises the potential of road vehicle to a maximum of 100 kV, the value depending on roughness of the road surface, vehicle speed and tyre tread resistance. The interconnection of these factors is given in the paper with both experimental and theoretically derived values of voltage. Harmful effects include shock from the vehicle, radio interference (small) and puncture of the inner tube due to ozone originating between the tube and the inner wall of the tyre. Elimination of these effects is obtained using tyres of electrical resistance of $<10^9\ \Omega$.

PA-57-3432

B-43. Bulgin, D.

3430. Factors in the design of an operating theatre free from electrostatic risks. D. BULGIN. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 87–S 91 (1953).

A theoretical treatment is given of the factors governing the voltage attained by surfaces under stated conditions of separation and electrical resistance. The results are supported by observed values and indicate that the resistance of rubber articles (measured under conditions defined by British Standard Specifications for anti-static and conductive rubbers) should lie between 100 000 Ω and 10 MΩ. It is considered that only "anti-static" (conductive) rubber and cotton surfaces should be permitted in operating theatres and that the relative humidity of the atmosphere should exceed 65%. PA-57-3430

B-44. Burkhardt, E.

***3967. Production of High Potentials by Use of a Unipolar Charged Air Current. E. Burkhardt.** *Ann. d. Physik,* **23. 4.** *pp.* **339–370,** *July,* **1935.**—The different methods available for the production of ions are reviewed. In the method used, a jet of water is forced by compressed air through an atomiser in the presence of a strong electric field. A charge density of 12 e.s.u. per c.c. was produced per sec. in a volume of 5×10^6 c.c.; an insulated electrode supported in the jet acquired a potential of 420 kV. The stream of ions produces an intense glow in the air up to a distance of 60 cm. from the jet. The change in electrical mobility of the droplets due to evaporation and agglomeration was investigated together with the variation in electric field-strength and the pressure distribution in the ion stream. The effect of the back electric field was examined and the efficiency of the apparatus was found to be about 1 %. A potential of 420 kV was reached, the value being limited by the electrical properties of air, which was the surrounding medium. By the use of two jets, two streams of ions of opposite sign may be obtained and a potential of double the previous value may be produced.**

PA-38-3967

B-45. Burton, E. F., and W. B. Wiegand

"Effect of Electricity in Streams of Water Drops," Phil. Mag. 23, 148-165 (1912).

B-46. Busch, H.

1632. *The Potential Gradient in the Vicinity of a Thin Wire.* H. Busch. (Zeits. f. Physik, 36. 3. pp. 188–192, 1926.)—This investigation has been undertaken to correct the erroneous view that in a cylinder condenser, whose inner conductor consists of a very thin wire, almost the entire potential decline takes place in the immediate neighbourhood of the wire. The paper is a criticism of a previous paper by Güntherschulze [see Abstract 587 (1926)] and an explanation of the Katsch observations [see Abstract 2140 (1925)]

PA-29-1632

B-47. Bush, H. J.

"Electrical Precipitation of Dusts," Industrial Chemist. pp. 97-100 (March 1938).

B-48. Busse, W.

1702. *Waterfall Electric Carrier-formation with Pure Water and Salt Solutions. Their Surface Conditions.* W. Busse. (Ann. d. Physik, 76. 5. pp. 493–533, April, 1925.)—After a short introduction the subject is dealt with as follows: Size distribution of negative and positive carriers generated by scattering distilled water; deciding the question whether groups of carrier-sizes are present; consideration of the travelling velocity formula; the origin of positive carriers in pure water; size and quantity of positive carriers generated by scattering in dependence on pressure; the positive carrier formation with bubbling action; carriers generated by solutions of common salt; the sign of the charge with carriers containing sodium; size of carriers and quantity of electricity developed in dependence upon the concentration; the surface conditions of salt solutions.

PA-28-1702

B-49. Butler, J. A. V. (ed)

See Electrical phenomena at interfaces. J. A. V. Butler [Ed.]. *London, Methuen* (1951) vii + 309 *pp.* Review in *Proc. Phys. Soc.* [*London*] *B*, 65, 828 (Oct., 1952).

PA-56-866

C-1. Cade, R.

23554 SURFACE TENSION AS A DOUBLE-LAYER PHENOMENON. R.Cade.
Proc. Phys. Soc. (GB), Vol. 81, Pt 2, 216-21 (Aug., 1963).
On the basis of the classical theory of electrostatic forces as previously extended by the author, it is shown that surface tension is, and perhaps is only, accounted for in terms of the change of stress which occurs at a liquid boundary when there is a double layer. The conclusion is drawn from a formula identifying surface tension with a functional of the double-layer field. This formula, taken in conjunction with measured values of the surface tension, could have application to the study of double layers.
PA-66-23854

C-2. Challande, R.

Electrostatic analysis of aerosols. Rene Challande. *Colloq. Intern. Centre Natl. Rech. Sci.* (Paris) No. 102, 441-7 (1961).
L'analyse des aérosols se propose de déposer les particules en suspension dans l'air ou dans les gaz sur des supports convenables pour faciliter leur observation. L'analyse électrique, basée sur les propriétés de l'effet couronne répond à ce désir et en plus opère un classement granulométrique. Les lois de charge sont différentes selon qu'on opère sur les particules dont la taille est supérieure ou inférieure au demi micron (particules microniques et particules submicroniques). L'appareil fonctionne convenablement aussi bien dans les atmosphères très polluées (échappement des moteurs à explosion) ou très pauvres en poussières (tropopause). Author

C-3. Challande, R.

2073. CONDUCTION OF MICRONIC AND SUB-MICRONIC SPHERICAL CONDUCTING PARTICLES IN AN INTENSE IONIZING ELECTRIC FIELD. R.Challande.
J. Rech. Cent. Nat. Rech. Sci., Vol. 6, 291-318 (Sept., 1955).
In French.
A comprehensive treatment of the subject ranging from methods of production of particles, methods of observation, acquisition of charges, theory of precipitation in an electric field, discussion of experimental techniques and investigation to some applications of the phenomena to industrial processes. 50 refs. 6 pp. of plates. PA-59 2073

C-4. Chalmers, J. A.

"Atmospheric Electricity," Reports on Progress in Physics 17, 101-134 (1954).

C-5. Chalmers, J. A.

11023. Electric charges from ice friction. J. A. CHALMERS. *J. atmos. terrest. Phys.*, 2, *No.* 6, 337-9 (1952).
Experiments are described showing that, when ice is rubbed, the large fragments carry a negative charge, in agreement with the theory of Simpson and Scrase for thunderstorm electrification. The present experiments extend the results of Pearce and Currie since they show charge separation even in the absence of air blasts. PA-57-11023

C-6. Chalmers, J. A.

Electricity of cloud and rain. CHALMERS, J. A. *Nature, Lond.*, 149, *pp.* 659–661, *June* 13, 1942.—The author discusses the electrical phenomena associated with continuous rain, as distinct from rain deposited by thunderclouds [see Abstr. 2006 (1942)]. The problem is to find a mechanism which will produce positively charged rain and a negative potential gradient. The ice-friction process of charge separation will give a negative potential gradient in which falling raindrops can acquire a positive charge by Wilson's influence mechanism. Observations of snowfall support this view, but are irreconcilable with Eiffel Tower observations of potential gradient. A series of experiments is suggested for investigating this apparent anomaly. PA-45-2501

C-7. Chapman, S.

"Thundercloud Electrification in Relation to Rain and Snow Particles," Byers, H. R. (ed.) "Thunderstorm Electricity," Univ. of Chicago Press, Chicago, pp. 207-230 (1953).

C-8. Chapman, S.

Mechanism of charge production in thunderclouds. CHAPMAN, S. *Amer. Phys. Soc.* (*Proc., July*, 1945). *Abstr. in Phys. Rev.*, 68, 103 (*Aug.* 1 *and* 15, 1945).—Measurements of spray electrification showed negative and positive charges in the air in nearly equal numbers, negative predominating, but the charge ratio varied markedly with spraying or bubbling procedure. If the charge ratio approaches unity by the breaking drop mechanism of thunderclouds, another order of magnitude of charge is available. Thus breaking drops may provide the required charges of both signs in the air, which may be separated by the Wilson mechanism in non-turbulent regions of the cloud, yielding, as observed, a positive cloud top and negative cloud centre and bottom, except for a localized volume in the updraft region containing positive charge on the breaking drops. PA-49-322

C-9. Chapman, S.

"Carrier Mobility Spectra of Liquids Electrified by Bubbling," Phys. Rev. 54, pp. 520-527 (1938).

C-10. Chapman, S.

3698. Carrier Mobility Spectra of Spray-Electrified Liquids. S. Chapman. *Phys. Rev.* 52, *pp.* 184–190, *Aug.* 1, 1937.—The mobility spectrum of spray-electrified salt solutions was investigated with an Erikson mobility tube under conditions of high resolving power. In general there are no charged carriers of mobility greater than 1·7 cm./sec. per volt/cm. Then the curves rise sharply, level out, and approach a broad maximum in the region between 0·05 and 0·10 cm./sec. per volt/cm. and then very gradually decrease toward zero. Superposed on this background striking peaks are observed indicating groups of unique mobility. With sprayed distilled water the most prominent peaks occur at mobilities of 1·5 for the negatives and 0·9 for the positives. Carriers of both signs occur in about equal quantities. With salts in the water the electrification increases up to a concentration of about $1·0 \times 10^{-4}$ N. It is then about double that for distilled water but at higher concentration it decreases. The salt occasions very strong peaks at mobility 0·5. It is concluded that the peaks represent stable groupings. PA-40-4698

C-11. Chapman, S.

3413. Charges on Droplets Induced by Spraying. S. Chapman. *Physics*, 5. *pp.* 160–162, *June*, 1934.—The Millikan oil drop method modified and applied to a study of the effect of drop size as related to charge in aneroil (a medicinal hydrocarbon, chiefly octane), nitrobenzene, aniline, glycerin and water. There is no preference for either sign of charge. The larger drops of both signs of charge have the larger charges, and the charge varies roughly in a linear fashion with drop-size except in the case of aneroil. There is a rough parallelism between dielectric constant and charge magnitude for drops of approximately the same size. Although there appears to be no correlation with viscosity, a parallelism between drop-size and surface tension exists which is, however, difficult to differentiate from the parallelism between drop-size and dielectric constant. The phenomena involved here, with slow droplets differ radically from those observed [see Abstract 1446 (1915)] with falling spray-particles. PA-37-3413

C-12. Charles, G. E., and S. G. Mason

8645 THE MECHANISM OF PARTIAL COALESCENCE OF LIQUID DROPS AT LIQUID–LIQUID INTERFACES.
G.E. Charles and S.G. Mason.
J. Colloid Sci., Vol. 15, No. 2, 105-22 (April, 1960).

The mechanism of formation of a secondary drop from the coalescence of a liquid drop (Phase 1) at a liquid–liquid interface was investigated. It was shown by means of high-speed photographs that partial coalescence results from the formation of a liquid column of Phase 1 in Phase 2 which contracts at the base and detaches itself to form the secondary drop. The diameter ratio, secondary to primary, varied with the viscosity ratio $p = \eta_1/\eta_2$, and passed through a maximum near $p = 1$. When p was less than 0.02 or greater than 11, no secondary drops formed. Secondary drop formation could be suppressed by adding a high concentration of surfactant or by applying an electrostatic field. The experimental results were analyzed with reasonable success with the aid of Rayleigh's theory of unstable liquid threads. PA-63-8645

C-13. Chaussidon, J.

"Diffuse Double Layer," Bull. groupe franc. argiles 10, No. 5, 27-30 (1958).

CA-53-16648h

C-14. Chih-En, G.

A note on the charge produced by spraying liquids with a jet of air. CHIH-EN, G. *Phil. Mag.*, 36, *pp.* 218–219, *March*, 1945.—The charge is calculated on the assumption that it arises from the change in surface tension produced when a drop, of radius R, breaks up into a large number of smaller drops. If the charge on each small drop is q it is shown that $q^2 \propto R^3$. PA-48-3013

C-15. Childs, E. C.

Space charge in the Gouy layer between two plane, parallel nonconducting particles. E. C. Childs (Univ. Cambridge, Engl.). *Trans. Faraday Soc.* 50, 1356–62 (1954).—The relation between the space charge and the particle charge was derived for plane parallel particles, such as many clay minerals, that were nonconducting and in which the charge distribution was const. and sym. about a medial plane. The calcn. of the potential distribution and repulsive pressure between the plates, by assuming that the Gouy layer charge was equal to the surface charge, was attended by negligible error. The Gouy layer and the charged particle on which it formed was a system in equil.; wherever the particle went, the Gouy layer accompanied it. The interaction between the charged surface and the ions in the layer produced mutual attraction between surface and layer, osmotic pressure variations in the layer, and accompanying hydrostatic pressure variations. None of these contributed any net force tending to translate the particle and its accompanying layer through the soln. CA-49-10007c

C-16. Church, F. W., and F. R. Ingram

"Apparatus for Dispensing Aluminum Dust in the Treatment of Silicotics," J. Ind. Hygiene and Tox. 30, No. 4, 246-250 (1948).

C-17. Ciborowski, J., A. Wlodarski

"On Electrostatic Effects in Fluidized Beds," Chem. Eng. Sci., 17, 23-32 (1962).

Abstract—The classical theory of fluidization does not take into consideration the possibility of the occurrence, in fluidized beds, of electrical forces conditioned by static electricity. The electric charges which accumulate on solid particles may cause:
(a) the adhesion of a layer of solid particles to the walls of the fluidizing equipment.
(b) the agglomeration of particles into larger aggregates.
(c) the change of a fluidized bed into a channelling bed.
Between metal elements which are in contact with the fluidized bed there may arise considerable potential differences, reaching even more than 15 kV.

Author

C-18. Clark, J. F.

"Fair-weather Atmospheric Electric Potential and its Gradient," on pp. 61-73, "Recent Advances in Atmospheric Electricity, Proc. 2nd Conf. on Atom Elect., Portsmouth, New Hampshire (May 20-23, 1958)." Pergamon Press, 1958.

C-19. Cochet, R.

10361 CHARGE OF SUBMICRONIC PARTICLES IN IONIZED ELECTRIC FIELDS. MEASUREMENT OF THE SPEED OF PRECIPITATION OF THESE PARTICLES IN A UNIFORM ELECTRIC FIELD. R.Cochet.
C.R.Acad.Sci. (Paris), Vol. 250, No. 12, 2164-6 (March 21, 1960).
In French.

Experimental verification of a previously described theory (Abstr. 1265 of 1957). An aerosol with particle sizes between 0.02 and 0.5 μ radius was entrained in an electric field across an ion beam. The precipitated globules were measured with an electron microscope. In the early stages of precipitation large and small particles (0.5 μ and 0.05 μ) were found. The end of the precipitation pattern showed only particles of the order of 0.1 μ. For electric fields between 1500 and 5000 V/cm, the mean free path of the ions was $l_c = l_g/2$.

PA-63-10361

C-20. Cochet, R.

1265. THEORY OF THE CHARGE OF SUBMICRONIC PARTICLES IN IONIZING ELECTRIC FIELDS; SPEED OF PRECIPITATION OF SUCH PARTICLES. R.Cochet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 3, 243-6 (July 16, 1956).
In French.

The classical law of charge for micronic particles is corrected to permit its application to submicronic particles. Estimated of precipitation rates based on this law are compared with those of Pauthenier (Abstr. 6121, 7945/1955) and H.J.White (Abstr. 4243 B/1951, Trans. Amer. Inst. Elect. Engrs II, Vol. 70, 1186, 1951). PA-60-1265

C-21. Cochet, R.

7756. Evolution of a charged water drop in a cloud above 0°c. R. Cochet. *Ann. Geophys.*, 8, 33-54 (*No.* 1, 1952) *In French.*

Various methods are examined to determine by calculation and graphically the coefficient of growth of an electrified water drop and next the growth of the drop in a fog. The general theory was verified experimentally in the particular case of cylinders, the trajectories of fog drops being photographed in the proximity of a charged cylindrical conductor. In the seeding of neutral clouds with water drops, electrified artificially or naturally, calculation showed that (1) the small electrified water drops increase in diameter rapidly in a short distance; (2) the electrification of water drops can in general act efficiently only on the initial stage which should start the precipitation. A drop of diameter 30 μ carrying a charge of 4×10^{-4} e.s.u. gives the same result as an uncharged drop of diameter 120 μ. For success in seeding the cloud must be of sufficient depth, possess an ascending current and be saturated and holding enough moisture to saturate layers below the cloud.

PA-55-7756

C-22. Cochet, R.

1922. Capture of uncharged particles by an electrified obstacle. R. Cochet. *J. Rech. Cent. Nat. Rech. Sci.*, 4, 153–80 (*June*, 1952) *In French.*

See Abstr. 4457 B (1951) *J. Rech. Cent. Nat. Rech. Sci.*, 3, (No. 15) 337–42 (1951) and Abstr. 7756 (1952). Further studies of losses in high voltage d.c. lines through fog. The general equation for the behaviour of a particle in the neighbourhood of a charged obstacle is derived. Graphical methods are then employed to trace the trajectories of fog droplets in the vicinity of charged cylinders. From these curves the coefficients of capture of droplets are deduced for the obstacles. The form of the trajectories in the neighbourhood of a h.v. conductor has been verified experimentally for stationary air conditions. The minimum quantity of water required to form drops on a smooth conductor capable of emitting ions has been determined and an estimate of the current loss can be made. The evolution of an electrified water drop in a cloud above 0°c is also studied and it is shown that small charged drops can grow rapidly while falling a short distance.

PA-57-1922

C-23. Coehn, A., and E. Duhme

2820. *Contact Electricity.* A. Coehn and E. Duhme. (Zeits. f. Physik, 27. 5–6. pp. 358–383, 1924.)—The charge on the bubbling of gases through liquid metal is independent of the nature of the gas. The only function of the gas is to break up the double layer always existing within the surface of the liquid and to carry charges with it. With non-metallic liquids the bubbling gas carries off negative charges; with pure mercury, positive, positive ions being allowed to escape with the gas and electrons retained. The sign of the escaping charge is reversed by the addition of traces of certain metals to the mercury, and its quantity greatly increased. The noble metals (Sn, Cu, Ag, Au) do not produce this effect.

PA-27-2820

C-24. Coolidge, J. E., and G. Shultz

2656. Note on static electrification of dust particles on dispersion into a cloud. J. E. COOLIDGE AND G. SCHULZ. Comment on static electrification of dust particles on dispersion into a cloud. W. B. KUNKEL. Letters in *J. Appl. Phys.*, 22, 103-4 (*Jan.*, 1951).

See Abstr. 7223 (1950). Attention is drawn to earlier work [Whitman, *Phys. Rev.*, 28, 1287 (1926)] which is in agreement. Kunkel gives added explanation. PA-54-2656

C-25. Cooper, W. F.

3419. The electrification of fluids in motion. W. F. COOPER. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 11-S 15 (1953).

The electrification of electrolytes by flow in pipes can be explained in terms of the Helmholtz electrical double layer, and it is suggested that some sort of double layer is also produced in commercial grades of organic liquids, such as petroleum, by impurities. The charge produced is expressed in terms of the electrokinetic potential and the Reynolds number. With an immersed discharge electrification will not be observed unless the resistivity exceeds about 10^{11} Ω cm. It is pointed out that the theory is closely associated with hydrodynamics and that in experiments the requirements of dynamic similarity must be observed if important scale effects are to be avoided, and the theory is extended to charges formed on filters and in washing fabrics. Such published experimental work as is available is consistent with the theory set out. The electrification of drops, spray and wet steam is also discussed briefly.

PA-57-3419

C-26 Cooper, W. F.

3434. The practical estimation of electrostatic hazards. W. F. COOPER. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 71-S 77 (1953).

Deals with experimental procedure and methods of calculation. An attempt is made to provide a basis for the quantitative study of electrostatic hazards met in industry and attention is drawn to several important details frequently overlooked. It is shown that a material cannot retain a bulk charge unless its resistivity exceeds about 10^{11} Ω cm and that vessels will not remain significantly charged unless they are very highly insulated. This depends very largely on the relative humidity of the air, and for this reason experimental work and measurements may present considerable difficulties in Britain. Problems of static electrification can be stated conveniently by a generalization of Maxwell's coefficients; examples are given, including a discussion of the interpretation of the indications of certain instruments, and the surface potential of a charged liquid in an earthed container—such as a bowl or a storage tank. The notation is suitable for other electrostatic problems as well as those considered. PA-57-3434

C-27. Cooperman, P.

24202 DUST SPACE CHARGE IN ELECTRICAL PRECIPITATION. P.Cooperman.
IEEE Trans Commun. Electronics (USA), No. 67, 324-6. (July, 1963)

The problem under consideration is that of calculating the reaction of the charged particles in an electric precipitator on the current. The major results are as follows: (1) duct precipitators are twice as sensitive to the presence of charged particles as pipe precipitators of the same interelectrode spacing; and (2) the interelectrode spacing is the only geometric factor entering into the calculation. These results extend earlier work on pipe to duct precipitators.

PA-66-24202

C-28. Corn, M.

"The Adhesion of Solid Particles to Solid Surfaces I.A. Review," J. Air Pollution Control Assoc. 11 No. 11, 523-528 (1961).

C-29. Couvertier, P.

9522 ELECTROSTATIC PHENOMENON RESULTING FROM THE PRESENCE OF SOLID PARTICLES IN AERODYNAMIC FLOWS. P.Couvertier.
C.R. Acad. Sci. (France), Vol. 252, No. 12, 1726-7 (March 20, 1961). In French.

Describes observations that the solid particles (e.g. talcum or aluminium powder) usually used for flow visualization in aerodynamics, can become electrically charged in the course of their motion, causing solids placed in the flow to be polarized. A description of how this phenomenon may be used as an electrostatic generator is given, though the figures quoted indicate the process to be singularly inefficient. Thus when a brass sphere of diameter 1 cm was placed in such a flow (at Mach number 0.8), a galvanometer between the sphere and earth indicated a mean current of 30 μA.

PA-64-9522

C-30. Crain, C. M.; D. C. Thorn, and J. E. Boggs

7844. THE DIELECTRIC CONSTANT OF SOLID PARTICLE AEROSOLS. C.M.Crain, D.C.Thorn and J.E.Boggs.
J. phys. Chem., Vol. 61, No. 6, 806-7 (June, 1957).

The dielectric constants of aerosols consisting of polystyrene, silver iodide or iron powder suspended in dry nitrogen, or oil smoke suspended in air have been measured at a frequency of 9400 Mc/s. The results are fitted well by a simple expression, in spite of the complexity and wide diversity of the systems studied. The observed data were well fitted by this equation even in cases where magnetic as well as electric interactions would be expected. PA-60-7844

C-31. Cree, K. H.

"Cottrell Electrical Precipitation as Applied to the Manufactured Gas Industry," Am. Gas J. 162, 27-30 (March 1945).

C-32. Crosby, E. J.

"Flow Properties of Dry Particulates," Am. Perfumer and Aromatics, 43-48 (September 1960).

C-33. Cross, A. S.

3415. **Two electrostatic field-meters.** A. S. Cross. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 47–S 50 (1953).

Two electrostatic field-meters are described, one operating from a.c. mains and the other from dry batteries. An alternating potential proportional to the field is generated by the measuring head, amplified, and fed to a phase-sensitive rectifier. The mains-operated instrument gives, at full sensitivity, an output current of 1 mA for a field of about 400 V/ft, the direction of the current depending upon the sign of the field. Its sensitivity can be adjusted over a range of 900 : 1; at maximum sensitivity the zero drifts by no more than 2% of the full-scale reading in 15 hr. The battery-operated instrument, which is truly portable, has two fixed ranges giving full output current for fields of 5 and 50 kV/ft; its sensitivity is hardly affected by normal changes in battery voltages.

PA-57-3415

C-34. Czyzak, S. J., and D. T. Williams

9436. **Static electrification of solid particles by spraying.** S. J. Czyzak and D. T. Williams. *Science*, 114, 66-8 (*July* 20, 1951).

The change in potential of a polyethylene sheet which has previously been charged, is measured when sprays of various liquids and powders are deposited. No change in potential occurs in the case of water, carbon tetrachloride and glycerine sprays, but with acetone, charcoal, starch and a 1 : 1 mixture of charcoal and starch an exponential decay of potential is observed, the rate of decay being dependent on the material used and (in the case of charcoal) on the density of the spray.

PA-54-9436

D-1. Dakin, T. W., and Berg, D.

"Theory of Gas Breakdown," Progress in Dielectrics, 4, Academic Press Inc., N.Y., 151-198 (1962).

D-2. Dallavalle, J. M.

"Micromeritics, the Technology of Particles," 2nd edition, Pitman, New York (1948).

D-3. Dallavalle, J. M., et al.

1284. The aggregation of aerosols. J. M. DALLAVALLE, C. ORR, JR AND B. L. HINKLE. *Brit. J. appl. Phys., Suppl. No.* 3 [*Physics of particle size analysis*] S 198-S 206 (1954).

Aggregation of the individual particles composing an aerosol is a phenomenon of primary importance in the ageing of the aerosol. The influence of electrification and foreign vapours on the aggregation process has been investigated. Results indicate that electrification amounting to a few electron charges per particle has little effect on the rate of aggregation, but has a decided influence on the shapes of the aggregates. In the case of aerosols whose particles have a significant vapour pressure, certain substances which lower this vapour pressure have been found to increase the rate of aggregation, presumably by reducing the vapour cushion surrounding the particles. When the particles are readily soluble in a substance whose vapour is present, the rate of aggregation also appears to be increased because of reduction of the vapour layer about the particles. PA-58-1284

D-4. Daniel, J. H., and F. S. Brackett

5875. An electrical method for investigating the nature and behavior of small, airborne, charged particles. J. H. DANIEL AND F. S. BRACKETT. *J. Appl. Phys.*, 22, 542-54 (*May*, 1951).

A theoretical and experimental analysis of the current-voltage (d.c.) characteristic of a parallel-plate condenser through which the small, airborne, charged particles of an aerosol are passed continuously shows that a charge-weighted distribution of radius (or radius squared)-charge ratio may be obtained when certain experimental conditions are satisfied. Examination of such a distribution for an aerosol (particles less than a micron in diameter) before and after passage through a small (20f) settling chamber shows that the classes of particles in the distribution that are easiest to collect in the condenser are also the classes that disappear most rapidly in the chamber. It is pointed out that the methods employed would become less tedious and more powerful when used with a dispersion of constant-size particles, and that they are well adapted for certain fundamental investigations of aerosol properties.

PA 54-5875

D-5. Dautrebande, L.

MICROAEROSOLS

PHYSIOLOGY, PHARMACOLOGY, THERAPEUTICS

By Lucien Dautrebande, *The Royal Academy of Medicine, Belgium*

1962, 366 pp., illus., $13.50

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D-6. Davies, C. N.

"Recent Advances in Aerosol Research," Pergamon Press, 80 pages (1964).

D-7. Davies, C. N.

"Inhaled Particles and Vapors," Proceedings of an International Symposium organized by the British Occupational Hygiene Society, Oxford (March 29-April 1, 1960). Pergamon Press, 1961.

D-8. Davy, N.

Ten two-dimensional electrostatic problems. Davy, N. *Phil. Mag.*, 36, *pp.* 153–169, *March*, 1945.—The first 9 problems are solved by the Schwarz-Christoffel transformation, the following results being found: (1) the transformations, (2) the field strengths, (3) the surface densities at points on electrodes, (4) the total charges on parts of electrodes, (5) the capacities between parts of electrodes, (6) expressions for the forces on small para- or diamagnetic bodies at some point in the field. Plots are given of the equipotentials. The electrode configurations are (s.i.r.e. = semi-infinite rectangular electrode): I. s.i.r.e. at potential V in line with a semi-infinite thin plate at potential zero. II. s.i.r.e. at potential V in line with a finite thin plate at potential zero. III. s.i.r.e. with thin finite central projecting plate at potential V. IV. s.i.r.e. with a thin finite central projecting plate at potential V in line with a semi-infinite thin plate at potential zero. V. Two equal s.i.r.e's. with thin finite central projecting plates at equal and opposite potentials facing each other. VI. s.i.r.e. with equal thin projecting plates at potential V. VII. s.i.r.e. with equal thin lateral projecting plates at the end, at potential V. VIII. Thin s.i.r.e. at potential V in line with a thin finite plate at potential zero. IX. Central finite thin plate at potential $-V$ between two other collinear thin plates at potential V. X. Two unequal thin collinear plates at potentials $\pm V$.

PA-48-3008

D-9. Debeau, D. E.

"The Effect of Adsorbed Gases on Contact Electrification," Phys. Rev., 66, Nos. 1&2, 9-16 (July 1 and 15, 1944).

The magnitude of the electrification produced on contact of quartz and of sodium chloride on nickel in atmospheres of air, oxygen, and nitrogen has been measured. Reproducible pressure-dependent results were obtained that indicate the contact electrification is a surface phenomenon and depends greatly on the nature of the surfaces involved. At least two layers of adsorbed gas play an important part in the phenomenon of contact electrification. In the pressure range from 760 to 30 mm at least one layer of adsorbed gas is removed. In this pressure range the surface covered with adsorbed gas makes the major contribution to the charge separation. At pressures below 0.1 mm at least a second layer of adsorbed gas is removed. In this pressure range the major contribution to the charge separation is made by the surface from which the second layer of gas has been removed. A fit of the data to Langmuir adsorption isotherms was obtained. Water vapor and perhaps hydrogen act as surface poisons in the phenomenon of contact electrification.

Author

D-10. Deodhar, G. B.

2354. *Electricity of Dust Clouds. Part I.* **G. B. Deodhar.** (Phys. Soc., Proc. 39. pp. 243–248; Disc., 248–249, April, 1927.)—Observations have been made qualitatively on a considerable number of dusts by blowing a large volume of air at high speed over them and measuring the resulting charge. The results agree with those of Rudge in some cases only. The electrification produced is frictional in character. From quantitative tests $NaNO_3$ is found to be more effective than KNO_3 and both better than KCl and NaCl. Tests on graded dusts of different sizes show that, other things being equal, the voltage developed by blowing increases very rapidly as the size decreases. The results are to be extended. The bearing of these facts on the electrification of dust clouds and dust storms is dealt with. In the *Discussion*, **P. E. Shaw** stated that the factor of humidity affects the result obtained and that the charge measured is a net one due to charges on the particles and on the ionised air, to impact on the walls and gauge of the chamber, and to ions emitted to the air, and these factors are not disentangled. **J. H. Coste** suggested that better grading of particles could be obtained by sedimentation and that the air might have been contaminated with dust before reaching the powder tested.

PA-30-2354

D-11. Deodhar, G. B.

2424. *Anomalies in Frictional Electricity.* **G. B. Deodhar.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 210–214, June, 1926.)—Anomalous frictional effects have been known since the time of Faraday. Rankine's observation about rough and smooth ebonite rods appears to depart from accuracy when the rubbing is prolonged; the ebonite pieces show reversals of sign. A few more substances are observed; of these india-rubber of red and grey varieties show similar reversals. From the considerable rise in temperature of the rubbing substances and from Jones's observation about definite relationship between the potential and the temperature of the substance, it appears that thermionics play a considerable part in frictional electricity. The reversals in ebonite and rubber may be due to the non-homogeneous nature of these substances.

PA-29-2424

D-12. Deryagin, B. V.

Deryagin, B. V.
AEROSOLS (SMOKE AND MISTS) (Aerozoli (Dymy i Tumany)). 11 Aug 61 [36]p. 12 refs. JPRS: 9883. Order from OTS or SLA #3.60 61-27689

Trans. of Vsesoyuznoe Obshchestvo po Rasprostraneniyu Politicheskikh i Nauchnykh Znanii. Seriya 9 (USSR) 1961, no. 3, 32p.

DESCRIPTORS: *Aerosols, Smokes, Particles, Condensation, Decomposition, Drops, Electrical properties, Pest control, Insecticides, Sprays, Drugs, Antibiotics, Artificial precipitation, Precipitation, Air, Purification, Warfare, Coatings.

Contents:
What is an aerosol?
The study of aerosols
The formation of air-dispersed systems
Decomposition of aerosols
Aids for the lecturer

T8-453

D-13. Deryagin, B. V., and S. S. Dukhin

Deryagin, B. V. and Dukhin, S. S.
MOTION OF AEROSOL PARTICLES IN A DIFFUSION FIELD (O Dvizhenii Aerozol'nykh Chastits v Pole Diffuzii). Feb 61 [12]p. 10 refs. RTS 1742. Order from LC or SLA mi$2.40, ph$3.30 61-15731

Trans. of Akademiya Nauk SSSR. Doklady, 1956, v. 106, no. 5, p. 851-854.

The forces acting on a drop in a homogeneous field are studied to clarify droplet behavior near surfaces at which evaporation or condensation occurs. A first approximation of a theory is mathematically derived. The mechanism of interaction caused by diffusion forces between uniform aerosol particles in which undersaturation affects aerosol coagulation is connected with diffusion polarization of the particles.

T5-516

D-14. Deryagin, B. V. (ed.)

23498 RESEARCH IN SURFACE FORCES.
Edited by B.V.Deryagin.
New York: Consultants Bureau (1963) 190 pp. An authorized translation from the Russian.

The 28 papers in this collection were first presented at the Conference on Surface Forces, convened at the Institute of Physical Chemistry of the Academy of Sciences, USSR, Moscow, in April, 1960. The collection was published in Russian in 1961 by the USSR Academy of Sciences Press, in Moscow, under the title "Issledovaniya v oblasti poverkhnostnykh sil" (Research in the Field of Surface Forces). Abstracts of some of the papers will appear in subsequent issues of Physics Abstracts.

PA-66-23498

D-15. Deryagin, B. V. et al.

"Electrical Phenomena Accompanying the Formation of New Surfaces, and their Role in Adhesion and Cohesion," in Second International Congress of Surface Activity III--Electrical Phenomena, Butterworths, London (1957).

D-16. Deutsch, W.

"Ist die Wirkung der elektrischen Gasreinigung dem elektrischen Wind zu verdanken?", Ann. Physik (5), 9, 249-264 (1931).

D-17. Deutsch, W.

2911. Charging of Particles Suspended in the Corona Discharge. W. Deutsch. *Ann. d. Physik*, 4. 6. *pp.* 823–828, *March* 26, 1930. Polemical against Schweitzer [see Abstract 2273 (1930)].

PA-33-2911

D-18. Deutsch, W.

1709. *Point Discharge and Electric Wind.* W. Deutsch. (Ann. d. Physik, 76. 7. pp. 729–736, May, 1925.)—The point discharge and the spectrum of the rays emitted have lately been the subject of investigation [see Abstract 1599 (1920)]. In the present paper the sharp imprint of the outer edges of the dust figure is seen in the radial diminution of the wind velocity in conjunction with the electric field of force at the ground surface of the point current. It is shown that, with higher tensions, not only the point itself, but also the surrounding part of the point have an essential share in the discharge, which is the cause of the dust being deposited in several ring-formed layers. The paper is illustrated with diagrams and photographs.

PA-28-1709

D-19. Deutsch, W.

"Bewegung und Ladung der Elektrizitätsträger im Zylinder Kondensator," Ann. Physik (4), 68, 335-339 (1922).

D-20. Dinger, J. E.

... Electrical effects associated with change of ... of water. DINGER, J. E. AND GUNN, R. *J. ... Meteor.* ..., 5, 477-98 (*Dec.*, 1948).—A ... of measuring the contact potential accompanying the freezing or melting of H_2O is described. A change of approx. 10 V. occurs rapidly at the time of freezing of the surface of the H_2O; after freezing the contact potential decreases at a rate depending on the temp. of the ice until the potential is approximately that which existed before freezing. The melting of the ice produces no appreciable change in the contact potential. The charge acquired by air in passing over a given vol. of freezing or melting H_2O, and that measured by the ice on melting are determined. H_2O on melting acquires a positive charge of about 125 e.s.u. per c.c. of melted H_2O, the surrounding air acquiring a numerically equal negative charge. The presence of air ... and may neutralize this charging effect, but the presence of dissolved gases is essential for the occurrence of the effect. This indicates that the phenomenon is related to the cataphoresis of gas bubbles.

PA-52-1891

D-21. Dodd, E. E.

2433. **The statistics of liquid spray and dust electrification by the Hopper and Laby method.** E. E. Dodd. *J. appl. Phys.*, 24, 73-80 (*Jan.* 1953).

The electric charges created upon individual microscopic particles of an aerosol during its generation have been determined by the Hopper and Laby oil drop method. In the spraying of non-conducting liquids, the charges produced upon droplets in the diameter range 2-50 microns are found to follow a normal distribution with the average charge zero and the mean square charge proportional to droplet volume. This result favours the electrification mechanism of statistical fluctuation of electrolytic ion concentration among the droplets rather than the more prominent Lenard mechanism. The charge distribution among clean mercury droplets in the diameter range 1-6 microns sprayed from a glass sprayer is asymmetric because of contact effects at the mercury-glass interface: the average droplet charge is positive, relatively large, and increases with droplet diameter. The dependence of dispersive dust charging upon particle surface roughness is illustrated by observations made with relatively smooth microscopic glass spheres and compared with data for rough crushed quartz particles.

PA-56-2433

D-22. Dougherty, T. J., and I. M. Krieger

Potential around a charged colloidal sphere. Thomas J. Dougherty and Irvin M. Krieger (Case Inst. of Technology, Cleveland, O.). *J. Phys. Chem.* 69, 1869-1872(1959).—

CA-54-5211c

D-23. Doyle, A., Moffett, D. R., Vonnegut, B.

"Behavior of Evaporating Electrically Charged Droplets," J. Coll. Sci., 19, 136-143 (1964).

Quantitative observations have been carried out on the behavior of evaporating, charged droplets, 60 to 200 microns in diameter, while they are electrically supported in an electric field between two horizontal metal plates. As the drop decreases in size, the electric charge density on its surface increases to values that produce potential gradients of several hundreds of kilovolts cm.$^{-1}$, until finally one or more small highly charged droplets are ejected and the suspended droplet thereby loses about 30% of its charge. The phenomenon is explained by Rayleigh's criteria for charged droplet stability within the accuracy of the observations.

Author

D-24. Drinker, P., and T. Hatch

"Industrial Dust; Hygienic Significance, Measurement and Control," McGraw-Hill, New York (1954).

D-25. Drozin, V. G.

7479. **The electrical dispersion of liquids as aerosols.** V. G. DROZIN. *J. Colloid Sci.*, 10, *No.* 2, 158–64 (*April*, 1955).

The dispersibility of a series of liquids at high electric potentials was investigated experimentally and theoretically. Large electrostatic pressure plays a predominant part in the process of dispersion and is a function of dielectric constant and radius of curvature of the liquid in the capillary. Nonpolar organic liquids having small dielectric constants could not be dispersed. Prediction of the dispersibility of a liquid can be made from knowledge of the value of its dielectric constant.

PA 58-7479

D-26. Drozin, V. G., and V. K. LaMer

5230. THE DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION OF AEROSOLS BY PRECIPITATION OF CHARGED PARTICLES. V.G.Drozin and V.K.La Mer.
J. Colloid Sci., Vol. 14, No. 1, 74-90 (Feb., 1959).

The method is based on the measurement of the macroscopic properties of a large number of particles. The electric current carried by a large number ($\sim 10^6$) of particles charged in a corona discharge and precipitated in an electric field, when measured as a function of precipitation time, is one such property. The number of charges acquired by particles is a single-valued function of particle size. From a knowledge of this function and measured values of current (or accumulated charges) versus time, the size distribution curve can be determined. The entire procedure, including the necessary calculation, takes about 20 min and requires relatively inexpensive equipment. All experiments were carried out with particles in the submicron range, the most difficult and at present the most important range. The size distribution of particles smaller than 0.2 μ radius could not be determined by this method, since their charging follows another law. Theoretically it is possible to overcome this difficulty.

PA-62-5230

D-27. Dubois, J.

8630 MEASUREMENT OF THE ELECTRIC CHARGE ON WATER AND SALT-SOLUTION DROPLETS DURING EVAPORATION AND CONDENSATION. J. Dubois. J. Phys. (France), Vol. 24, No. 9, 661-4 (Sept. 1963). In French.

Describes work on electric charges on water or [illegible] droplets, whose diameter is about 1–100 μ. If the droplet vapour pressure is the same as that of surrounding air, it seems to carry fewer electric charges, in relation to its diameter. If droplet vapour pressure is not in equilibrium with that of air, evaporation of water from the droplet carries away negative charges and condensation of water vapour on the droplet brings positive charges. An attempt is made to explain the observations.

PA-67-5539

D-28. Dukhin, S. S., and B. V. Deryagin

Dukhin, S. S. and Deryagin, B. V.
ELECTRICAL FIELD OF A MOVING DROPLET. I. THE THEORY OF THE ELECTRICAL FIELD OF A DROPLET CONTAINING AN IONOGENIC SURFACE-ACTIVE COMPOUND. 17 Aug 61 [21]p. 5 refs. MCL-1192/1+2.
Order from OTS or SLA $2.60 61-28533

Unedited rough [illegible]s. of *Kolloidnyi Zhurnal (USSR) 1959, v. [illegible] 1, p. 37-49.

DESCRIPTORS: *Drops, *Electric fields, Theory. Surfaces, Electrolytes, Adsorption, Diffusion.

Calculations on not excessively large droplets, the fall of which is characterized by Reynolds numbers less than unity, showed that the electrokinetic diffusion effect may lead to electrical fields of 100 volt/cm. (See also 59-13213)

T7-14

D-29. Dukhin, S. S. et al.

3774 Flow Methods for the Size and Charge Determination of Coarse Aerosol Particles.– A new procedure for measuring the electric charges was proposed, based on determination of the settling of particles from a laminar flow under the action of a lateral electric field. The setup is recommended for use with aerosols of high particle charge. (*In Russian.*) Potochnye metody izmereniia razmerov i zariadov chastits grubodispersnogo aerozolia. – S. S. Dukhin, V. N. Orlov, L. A. Perekupka, and K. A. Kaltseva. *Kolloidnyi Zhurnal*, v. 26, no. 1, Jan.-Feb. 1964, p. 133-138.

BMI 13-3774

D-30. Dunskii, V. F., and A. F. Funikov

DUNSKII, V. F. and FUNIKOV, A. F.
R-5211. Tests of a helicopter with an aerosol generator. Zashchita Rastenii ot Vrediteleĭ i Bolezney, no.3, p.20-21, May and June, 1958.(4p.)

D-31. Dunskii, V. F., and A. V. Kitaev

10113* Precipitation of a Unipolar Charged Aerosol in a Closed Room. Experiments were made on the precipitation of a unipolar aerosol in a chamber 1.2 m³ capacity. The charge was induced by atomizing the liquid in an electrical field. The theoretical and experimental results approximately agree if it is assumed that the charges are distributed among the droplets proportionally to the radius of the latter. (*In Russian.*) Osazhdenie unipoliarno zariazhennogo aerozolia v zakrytom pomeshchenii. *V. F. Dunskii and A. V. Kitaev. Kolloidnyĭ Zhurnal*, v. 22, no. 2, Mar.-Apr. 1960, p. 159-167.

BMI 9-10113

D-32. Dunskii, V. F., and A. V. Kitayev

Dunskiy, V. F. and Kitayev, A. V.
ELECTROSTATIC SPRAYING (Elektrostaticheskoye Opryskivaniye). June 59 [7]p. RTS no. 1033.
Order from LC or SLA mi$1.80, ph$1.80 59-18160

Trans. of Zashchita Rastenii ot Vrediteley i Bolezney (USSR) 1958 [v. 3] no. 4. p. 17-18.

T2-381

D-33. Dunskii, V. F., and N. S. Smirnov

14086* Concerning the Influence of Ionizing Radiation on the Dispersion of Aerosols. It has been shown experimentally that condensation fogs are charged very slowly under the natural conditions of atmospheric ionization. Irradiation by γ-quantums of Co^{60} of a stream of such fogs influences the decrease in dispersion of the microscopic particles and facilitates filtration of the finer fractions of the fog. (*In Russian.*) K voprosu o vliianii ioniziruiushchikh izlucheniĭ na dispersnost' aerozoleĭ. *V. F. Dunskii and N. S. Smirnov. Kolloidnyĭ Zhurnal*, v. 21, no. 4, July-Aug. 1959, p. 436-441.

BMI 8-14086

D-34. Durand, E.

16896 POTENTIAL OF A UNIFORM DISTRIBUTION OF CHARGE ON AN INFINITE CONE. E.Durand. C. R. Acad. Sci. (France), Vol. 255, No. 18, 2241-3 (Oct. 29, 1962). In French.

Expressions are given for the potential and electric field components on either side of an infinite cone with a uniform surface distribution of electric charge. The potentials are obtained (Abstr. 1923, 3989 of 1963) by superposing the potential of a line charge distribution on that of a uniform field. The method is applicable to any surface distribution of charge developable in a convergent infinite series.

PA-66-16896

D-35. Durand, E.

4376. POTENTIAL OF A UNIFORMLY CHARGED DISK. E.Durand. C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 887-9 (Feb. 13, 1956). In French.

A continuation of previous work. A general expression for the potential at any point outside the disk is given.

PA-59-4376

D-36. Dzoanh, N.

19552 INVESTIGATION ON VERY HIGH VOLTAGE GENERATORS USING A STREAM OF ELECTRIFIED PARTICLES UNDER INTERNAL PRESSURE. CONSTRUCTION OF A PROTOTYPE UNDER 10 kg/cm^2. Nguyen-Trinh Dzoanh. J. Rech. Cent. Nat. Rech. Sci. (France), No 58, 45-78 (March, 1962). In French.

The usual types of high voltage generators are considered and their shortcomings pointed out. A generator has been designed in which the charge is carried on non-conducting particles which are circulated by means of a blower. The particles are of glass of a few microns diameter. The theory of the generator is given and the construction and performance of a prototype is described. It is found that the output current is proportional to the internal pressure and so is the collector potential. Thus raising the pressure increases both the power output and the efficiency of the generator. The experimental results agree well with the theory.

PA-65-19882

E-1. Earhart, R. F.

"The Sparking Distances Between Plates for Small Distances," Phil. Mag. 1, 147-159 (1901).

E-2. Ehrenhaft, F.

531. *Mobility of Small Spheres in a Gas, and their Electrical Charges.* F. Ehrenhaft. (Zeits. f. Physik, 39. 9. pp. 603-606, 1926.)—The constants of the law of resistance, as found by various observers for liquid and solid particles of radius greater than 10^{-5} cm., are collected. The mobility of all such particles is expressed in terms of the viscosity of the gas, the radius of the particle and the length of its mean free path. The charges on particles of smaller capacity than 3×10^{-5} cm. are smaller than the quantum of electricity, being in some cases only half as great as the latter. [Abstracts 2009 (1925) and 2497 (1926).]

PA-30-531

E-3. Einbinder, H.

5436. GENERALIZED EQUATIONS FOR THE IONIZATION OF SOLID PARTICLES. H.Einbinder.
J. chem. Phys., Vol. 26, No. 4, 948-53(April, 1957).

A generalized formula is derived for the ionization of spherical solid particles of submicroscopic size by allowing for multiple ionization. A system of simultaneous equilibrium equations is set up connecting successive states of ionization. Its solution yields a generalized formula that reduces to the Saha equation when only single ionization can occur. When the particles are multiply ionized, the equation can be simplified by the method of steepest descents,

$$N_e/N = (rkT/e^2)\ln(K/N_e) + \tfrac{1}{2}, \quad (N_e/N > \sim 3),$$

where N_e is the electron concentration, N is the number density of solid particles, r their radius and $K = 2(2\pi mkT/h^2)^{3/2}\exp(-\varphi/kT)$. This equation is applied to the observations of Sinclair and Weber on the ionization of free carbon particles produced in rich acetylene–oxygen flames. Their data is consistent with a work function $\varphi = 4.35$ eV, identical with that of graphite, and particle radii between 55 and 85 A.

PA 60-5436

E-4. English, W. N.

"Corona from a Water Drop," Phys. Rev. 74, No. 2, 179-189 (July 15, 1948).

Studies with a water drop point in a point-to-plane gap have yielded important results. Such a point has a very low secondary electron emission coefficient, and for the first time a large difference in positive and negative intermittent onset potentials in air, due to this, has been observed. The luminosity obtained with a negative drop point and the complex oscillograph pulses on both polarities have been accounted for by considering positive corona from charged droplets leaving the water point and assuming that true negative corona from a water surface is impossible. The space charge weakening of the field about a positive point, long assumed to explain the disappearance of the pre-onset streamers, is here confirmed by the reappearance of a stable drop point well above the initial potential required for disruption of the water surface.

Author

E-5. Eraldo, N., and A. Martinetti

ARRANGEMENT FOR ELIMINATING ELECTROSTATIC CHARGES FROM ANY MATERIAL CHARGED THEREWITH, PARTICULARLY BUT NOT EXCLUSIVELY SUITABLE FOR DISCHARGING STATIC ELECTRICITY ACCUMULATED IN YARNS OF TEXTILE FIBERS AND IN FABRICS, tr. by J. B.
24 Jan 62, 4p. (1 fig. omitted).
Order from OTS or SLA $1.10 62-15758

Trans. of Italian patent 450,020, cl. 19, appl. 17 Dec 48, granted 7 July 49, printed July 50.

DESCRIPTORS: Fibers, *Textiles, Threads, *Static electricity, Electric discharges, Direct current, *Electrostatics, Static eliminators

The arrangement is characterized in that the material, which enters between drawing elements connected to a high voltage direct current source and insulated electrically from the rest of the machine, passes between plates that are interconnected electrically and equipped with points of suitable length inclined in the direction opposite to the (direction of) movement, and leaves at the other side.

T7-1037

E-6. Ernsberger, F. M.

337. MECHANISM OF FRICTIONAL ELECTRIFICATION OF DIELECTRIC LIQUIDS. F.M.Ernsberger.
J. appl. Phys., Vol. 27, No. 4, 415-19 (April, 1956).

A new theory is proposed, based on the results of some experiments on the electrification of hydrocarbon fuels. It is suggested that a layer of chemically-adsorbed, electrically-neutral molecules exists at the interface between solid and liquid. The adsorption is assumed to be so weak that thermal activation at ordinary temperatures is adequate for maintaining dynamic equilibrium between adsorption and desorption. To account for charge separation it is proposed that some of the desorptions are anomalous, in that a molecule may desorb with either an excess or deficit of electrons. About one in 10^{23} desorptions need be anomalous to account for the current densities which are normally observed.

PA-60-337

F-1. Facy, L., and E. Darmois

Facy, L. and Darmois, E.
ON THE MOTION OF AEROSOL PARTICLES IN THE COURSE OF THE PROCESS OF MOLECULAR DIFFUSION. [1965] [7p] 5mds
Order from SLA $1.10

Tylne. of [Academie des Sciences, Paris]. Comptes Rendus[us] (France) 1958, v. 246, p. 102-[104] (pub. by Gauthier-Villars et Cie., Paris).
T12-43

F-2. Faraday Society: "Physical Phenomena at Interfaces"

1189. ***Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation.*** **(Faraday Soc., Trans. 22. pp. 434–500, Dec., 1926.)—A general discussion on the subject comprising the following nine papers, together with expressions of views by various contributors: "General Discussion on Physical Phenomena with Special Reference to Molecular Orientation (Introductory Survey)," by E. K. Rideal. In the case of insoluble films on a liquid surface the evidence for a two-dimensional unimolecular phase capable of existing in the solid, two liquid, the condensed and expanded, vaporous, gaseous and allotropic solid states has been confirmed and extended. The conditions of equilibrium of these films with crystals or lenses of materials from which they are formed conform to the generalisations embraced by the phase rule. Interfacial electrification, the evidence supporting the view that adsorbed molecules are orientated, and allied subjects are also considered.—" Electrification at Interfaces," by H. Freundlich. Electrification at interfaces is governed by the distinction between the thermodynamic potential and the electrokinetic potential, this distinction necessitating two assumptions: (1) The electric double layer at the interface must be, not a strict double layer as suggested by Helmholtz, but a so-called " diffuse " double layer in which the ions of the layer in the liquid phase are not all strictly bound to the one surface. (2) A thin film of the liquid adheres firmly to the solid wall of the other phase. The thermodynamic potential is the true potential between the two phases, whereas the electrokinetic potential is the potential between the movable liquid phase and the thin film of liquid adhering to the solid wall. Experimental data referring to the behaviour of these two potentials are discussed, and it is shown that the distinction between the two is a valuable guide in the study of the phenomena correlated with the electrification of surfaces.—" Electrification at Interfaces," by R. K. Schofield. By restraining free kinetic movement, the interfacial forces which cause adsorption and molecular orientation set up a distribution of volume electrification, thereby giving the surface an electric moment and hence a transverse difference of potential. The study of the electric moment of an interface by observation of the relation of its charge to the accompanying change in surface tension is best carried out by means of Gibbs' thermodynamic adsorption equation, which reveals great complexity in the ionic and molecular arrangements making up the electric moment of an interface and shows the complete inadequacy of the simple theory of an interfacial " condenser." Thus, it shows that the disturbance set up by a charged mercury surface in a neighbouring solution extends to a considerable depth (tenths of Å.), and supports the view that throughout part at least of the region carrying volume electrification the ions are separated by a medium of which the dielectric constant does not differ greatly from that of water in bulk. Molecules orientated at an interface and having electric moments either inherent or induced, though they contribute to the total p.d., cannot cause electrokinetic phenomena, for the appearance of which the possibility of a relative movement of two layers carrying volume electrification of opposite sign would appear to be essential.—" Adsorption on Solids," by W. E. Garner.** Reference is made to the part played by the fine structure of the solid surface in adsorption processes and in the kinetics of heterogeneous reactions, to surface energy and surface forces, to adsorption isotherms, monomolecular films, molecular orientation, etc.—" Molecular Orientation in Solids," by **G. Shearer.** The bearing of X-ray measurements on this subject is considered. Study of the structure of long-chain carbon compounds shows that there is one set of planes in the crystal whose spacing is very much greater than with the other planes, and that this spacing increases uniformly with the carbon content of the molecule. Moreover, in any one series of carbon compounds the unit cells are of approximately the same cross-section, the area, about 41·4 Å^2., being a measure of the space occupied by the base of two molecules. Some doubt still exists as to the precise arrangement of the molecules lengthwise. The relative strengths of certain of the bonds joining molecule to molecule, the relationship between the type of orientation found in molecular aggregates other than solids and that which is the principal characteristic of the crystal, the probability that the double and single layers found in long-chain crystals have considerable bearing on the formation of oriented films, the inactivity of the groups at the outer ends of the double layer, etc., are also discussed.—" Insoluble Films on Liquid Surfaces," by **N. K. Adam** and **G. Jessop.** See Abstracts 1199 and 1200 (1926).—" Spreading of Proteins," by **E. Gorter** and **F. Grendel.** Proteins are able to spread on water in a monomolecular layer. Hæmoglobin, casein, serum proteins and muscle proteins spread in a film only 6·75 Å. in thickness if the suitable hydrogen ion concentration (mostly pH = 1) and temperature are chosen. Other proteins (gelatin, gliadin) do not spread well, their behaviour being comparable to that of the short-chained fats. When spread on distilled water, proteins do not show this minimal value for the thickness of the layer; in this case time has a considerable influence, whereas it has none when strongly acid water is used. At the isoelectric point and at pH = 1 or 2, the very thin monomolecular film is obtained, but on either side of this point the thickness increases, often threefold. Rise of temperature enhances the spreading only of proteins of the hæmoglobin and casein type, but the spreading of proteins of the gelatin-gliadin group is better at lower temperatures. The spreading of proteins in thin films is due to the attraction of the CO.NH groups of the molecule to the water. Certain points of technique are discussed.—" Some Physical Properties of Composite Surfaces," by **W. Ramsden.** Such questions as massed adsorpta, the viscosity or rigidity of adsorption surfaces, the re- or in-solubility of massed adsorpta, surface rigidification, etc., are briefly discussed.—" Arrangement of Molecules on the Surface of Pure Liquids," by **S. Sugden.** The assumption of a particular orientation of the molecules of thin surface films furnishes the simplest and most complete interpretation of the behaviour of such films under compression and of the regular and consistent values found for the dimensions of molecules. In the present state of knowledge it is impossible to prove that orientation cannot occur at the surface of a pure liquid, but it has been shown that such an ordered arrangement of the surface molecules, if existing, does not affect the total surface energy as would be expected, and that the kinetic theory sets definite limits to the existence of any high degree of orientation. The author is of the opinion that the surface properties of pure liquids are best accounted for by the theory of a random distribution of the surface molecules.

PA 43-304

Faraday Society--Symposium on Electric Double Layer

294. The electrical double layer. *Faraday Soc., Trans.*, **36**, *pp.* 1–333, *Jan.*, 1940.—A general Discussion of the subject comprising 39 contributions.

"General Introduction," by E. K. RIDEAL (*pp.* 1–4).—Reviews very briefly the physical and biological significance of the double layer, stressing particularly the lack of precision in knowledge of the origin and structure of the layer.

PART I. EXPERIMENTAL METHODS AND RESULTS.

(A) Electrophoresis.

"Microscopic method of electrophoresis and its application to the study of ionogenic and non-ionogenic surfaces," by H. A. ABRAMSON (*pp.* 5–18).—Reviews apparatus, experimental methods and results obtained since the publication of Ellis's pioneer work in 1912.

"Influence of electrolyte concentration on electrophoretic mobility of egg albumin," by A. TISELIUS AND H. SVENSSON (*pp.* 16–22).—The influence of salts upon the electrophoretic mobility and isoelectric point of egg albumin has been determined by the moving boundary method; theories of the phenomena are advanced.

"Membrane potentials, valencies and theoretical and observed mobilities of haemoglobin and egg albumin," by G. S. ADAIR AND M. E. ADAIR (*pp.* 23–32).—Membrane potentials, valencies and the excess of inorganic ions in the neighbourhood of a protein ion have been studied for comparison with measurements of the cataphoresis of dissolved proteins. Observed mobilities of haemoglobin ions agree with results calculated by using Henry's formula.

"Influence of electrolytes on electrophoretic mobility of serum albumin and haemocyanin," by P. PUTZEYS AND P. VAN DE WALLE (*pp.* 32–38).—The molecular dimensions of the proteins place them in the lower boundary of an intermediate region between the two extremes represented by the equations of Smoluchowski and Hückel for electrophoretic mobility; the behaviours of serum albumin and haemocyanin in the presence of electrolytes are studied.

"Use of thin layers in electrophoretic separation," by J. ST. L. PHILPOT (*pp.* 38–46).—A large scale electrophoretic separator, made of "Perspex," in which the substance to be separated flows in a thin layer between layers of dilute electrolyte, is described.

"Observations at the electrophoretic moving boundary with Lamm's scale method," by R. A. KEKWICK (*pp.* 47–52).—A survey of the use of Lamm's method.

"Examination of electrokinetic charge density as a function of the thickness of the double layer," by A. J. HAM AND E. D. M. DEAN (*pp.* 52–57).—Measurements of the electrophoretic mobilities, potentials and charge densities of octadecane in the presence of the chlorides of Na, Ba and La at 25°C. at pH = 5 are recorded and discussed.

"Properties of detergent solutions. Part IX. Electrophoretic mobility of oil drops in detergent solutions," by J. POWNEY AND L. J. WOOD (*pp.* 57–63).—A mean value of 4·36μ /sec./V./cm. at 25°C. is found for the electrophoretic mobility of "Nujol" dispersed in water; the influence of added alkalies and long-chain colloidal electrolytes is examined. [For Part X see following Abstract (*p.* 81).]

"Electrokinetics as a tool for study of molecular structure of organic compounds," by R. A. GORTNER (*pp.* 63–66).—The electrokinetics of the aliphatic alcohols and acids, ethyl esters of the aliphatic acids, acetates of the aliphatic alcohols, 6 benzene derivatives and CCl_4 at a cellulose-organic liquid and an Al_2O_3-organic liquid interface have been studied.

(B) Streaming Potentials and Surface Conduction.

"Streaming Potentials and Surface Conductance," by A. J. RUTGERS (*pp.* 69–80).—Results obtained with old and new forms of apparatus are surveyed; anomalous behaviour of the ζ-c curve for KCl solutions is attributed to surface conductance. The Helmholtz-Smoluchowski equation is derived and corrected.

"Electroviscous effect in egg albumin solutions," by H. B. BULL (*pp.* 80–84).—The viscosity of dilute solution of egg-albumin (conc. <1%), at pH 1–11, has been studied at 35°C. Neither the Smoluchowski nor the Krasny-Ergen equation gives the correct order of magnitude for the electroviscous effect.

(C) Electrocapillarity and Other Methods.

"Electrochemistry of simple interphases, with special reference to that between mercury and solutions of electrolytes," by S. R. CRAXFORD (*pp.* 85–101).—A general survey and discussion.

"Ionic concentration at interfaces," by G. S. HARTLEY AND J. W. ROE (*pp.* 101–109).—The significance of ζ-potentials in determining ionic concentrations at interfaces is discussed in considerable detail.

PART II. THEORETICAL TREATMENT OF THE DOUBLE LAYER AND ITS IMPLICATIONS.

"Introductory Paper," by H. R. KRUYT AND J. T. H. OVERBEEK (*pp.* 110–116).—A critical review of the mechanism of the double layer; a simple relation between electrophoretic mobility and colloid stability does not exist.

(A) Electrokinetic equations.

"Study of double layer at metal-solution interface by electrokinetic and electrochemical methods," by A. FRUMKIN (*pp.* 117–127).—A critical review, more especially of the properties of Pt and Hg electrodes.

"Observations on the double-layer capacity at Hg electrodes," by I. M. BARCLAY AND J. A. V. BUTLER (*pp.* 128–133).—An oscillographic study of the negative polarisation of freshly made Hg surfaces shows the presence of 2 stages. There is no evidence that adsorbed H_2 is deposited at any potential below that at which H_2 is continuously evolved.

"Relaxation effects in the double layer. Cataphoresis; dielectric constant," by J. J. HERMANS (*pp.* 133–139).—The theory of double-layer distortion for charged spherical particles moving in an external electric field is surveyed.

"The Helmholtz," by E. A. GUGGENHEIM (*pp.* 139–144).—The measurement of the moment (τ) of an electrical double layer in volts shows confusion of thought. A suitable unit for τ is the Helmholtz, defined as 1 Debye/Å^2; the conversion of volts to Helmholtz is given by ζ volts = Dζ/12 Helmholtz, where D is the dielectric coefficient.

"Application of Debye-Hückel theory to disperse systems," by R. AUDUBERT (*pp.* 144–153).—The Debye-Hückel theory in its classical form applies to disperse systems only when the ionic strength of the solution is very small; its extension to strong solutions necessitates the integration of additional terms other than the first of the Debye-Hückel equation and the consideration of surface processes such as selective adsorption and chemical reactions.

"Electrokinetic equations and surface conductance. Survey of diffuse double-layer theory of colloidal solutions," by J. J. BIKERMAN (*pp.* 154–160).—Electrokinetic equations, corrected to take account of surface conductance of capillary and colloidal systems, account for the maximum of ζ, the high dielectric constant of some sols, etc., and can be used to obtain definite values of ζ.

(B) Adsorption potentials.

"Adsorption potentials. Part I. General theory," by R. B. DEAN, O. GATTY AND E. K. RIDEAL (*pp.* 161–166).—Thin layers of insoluble substances, permeable to at least one ionic species can only affect diffusion potentials between 2 phases when they offer sufficient change in the resistance to passage of at least one ionic species. An expression for the diffusion potential through a thin permeable membrane is derived.

" Adsorption potentials. Part II. Oil-water potentials," by R. B. DEAN (*pp.* 166–173).—A method for investigating the electrical properties of oil-water interfaces is described, and results supporting the conclusions of Part I (see above) are detailed.

" Adsorption potentials. Part III. Air water potentials," by R. B. DEAN AND O. GATTY (*pp.* 173–179).—The mechanism at air-monolayer-aqueous solution interfaces attracting ionized air particles is discussed.

(C) Colloid stability.

" Rôle of forces between particles in electro-deposition and other phenomena," by H. C. HAMAKER AND E. J. W. VERWEY (*pp.* 180–185).—Electro-deposition is mainly a *mechanical* problem, the electric field merely moving the particles towards, and pressing them on to the electrode.

" Influence of particle size on physical behaviour of colloidal systems," by H. C. HAMAKER (*pp.* 186–192).—The various forces concerned in the physical behaviour of colloidal systems and their dependence on particle size are discussed; the behaviour of colloidal systems under gravity and in a centrifuge is treated.

" Electrical double layer and stability of emulsions," by E. J. W. VERWEY (*pp.* 192–203).—Discusses why a stable emulsion cannot be obtained without the presence of a special emulsifier.

" Repulsive forces between charged colloid particles, and theory of slow coagulation and stability of lyophobe sols," by B. DERJAGUIN (*pp.* 203–216).—A mathematical theory of the forces operative between particles and determining the stability of sols, suspensions and emulsions, with applications to thixotropy, etc., is developed. Agreement between theoretical and experimental determination of the force of repulsion between surfaces separated by liquid films is not satisfactory.

" Stability properties in hydrophobic sols: application of mutual energy of two particles," by S. LEVINE AND G. P. DUBE (*pp.* 216–229).—Applications of the expression, given by the authors, for the mutual energy of two colloidal hydrophobic spherical particles, are discussed.

" Significance of phenomenon of electrical charge in stability of hydrophobic dispersions," by H. EILERS AND J. KORFF (*pp.* 229–241).—Data on which are based the relation between the ζ-potential and the stability of lyophobic colloidal systems, are critically reviewed, and a more satisfactory, approximate relation is established between electric boundary phenomena and the stability of the system.

" Electrical double layer in relation to stabilization of emulsions with electrolytes," by D. F. CHEESMAN AND A. KING (*pp.* 241–247).—Generalizations, based on recent experimental work, relating to the stabilization of amyl alcohol/water emulsions with various electrolytes, are presented.

PART III. BIOLOGICAL AND TECHNICAL APPLICATIONS.

" Use of electrophoresis in the elucidation of biological problems," by L. S. MOYER (*pp.* 248–256).—A survey of recent work.

" Electrical double layer and virus stability," by A. S. MCFARLANE (*pp.* 257–264).—A survey of recent work.

" Consequences of electrical double layer in rubber technology," by D. F. TWISS, A. S. CARPENTER AND P. H. AMPHLETT (*pp.* 264–271).—The subject is reviewed generally and new work relating to the coagulation of dialyzed *Hevea* latex is presented.

" Anodic deposition of oleo-resinous lacquers," by C. G. SUNNER (*pp.* 272–278).—A method of lacquering metal surfaces by electro-deposition from an oleo-resinous emulsion, developed primarily for the internal coating of tinplate cans, is outlined.

" Formation of deposit by electrophoresis," by H. C. HAMAKER (*pp.* 278–287).—The production of coatings by electrophoresis from suspensions of $BaCO_3$, $BaSr(CO_3)_2$, $SrCO_3$, MgO, $MgCO_3$, Al_2O_3 and CaF_2 in methanol, ethanol, acetone or mixtures of these fluids is discussed.

" Deposition of oxide coatings by cataphoresis," by M. BENJAMIN AND A. B. OSBORN (*pp.* 287–295).—Experimental work concerned with the production of non-colloidal cataphoretic suspensions of the alkaline-earth carbonates and alumina, from which the particles may be deposited along with a cellulose binder is described.

" Wetting and flotation in connection with problem of transition layer," by P. REHBINDER (*pp.* 295–305).—A survey.

" ' Amphoteric ' double layer and the double ionic exchange in soils," by S. MATTSON AND L. WIKLANDER (*pp.* 306–319).—The simultaneous exchange of anions and cations at the equi-ionic point of soils occurs according to the mass law expressed by the Donnan equilibrium. The double ionic exchange leads to the conception of an " amphoteric " electrical double layer. PA 43-304

F-4. Fedoseev, V. A., B. A. Manakin, and Z. M. Domentianova

"Mutual Coagulation of Aerosols," Colloid Journal (USSR) 14, 470-477 (1952).

F-5. Felici, N. J.

3424. Ten years of research on electrostatics at the University of Grenoble 1942–1952. N. J. FELICI. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 62–S 67 (1953).

The emphasis is on the practical development and application of electrostatic generators, rather than on theoretical considerations. The small cylindrical compressed-gas generators with conducting segments proved very satisfactory for powers of the order of 30 W at voltages of 70 kV. In attempts to increase the output multiplate generators with conducting segments were evolved which reached 750 W at 250 kV, but beyond this range difficulties of mechanical construction proved formidable. After disproving the current view that charge slip was responsible for the low output of moving insulator machines, a cylindrical generator of this type was constructed with highly encouraging results. PA-57-3424

F-6. Fleming, A.

286. Electrification of powdered insulators. A. FLEMING. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 51–53, *Jan.*, 1941.—Experiments are described whereby the production of a negative charge, as a result of the fall of a dielectric powder from a metal or glass receptacle into a metal container, is demonstrated. It is necessary that a good insulator, such as powdered sulphur or silica, be employed and, in the case of the latter, it must be previously very well dried by heating. By means of a rotating cylinder a small quantity of powder may be utilized to give an unlimited supply of charge. It is concluded that, when dielectric particles strike a metal surface with some velocity, electrons tend to pass from the latter to the former. The negatively charged particles are capable of acting as condensation nuclei in steam. PA-44-286

F-7. Fleming, A.

2632. New Method of Creating Electrification. (Sir) Ambrose Fleming. *Phys. Soc., Proc.* **51.** *pp.* **402–406,** *May,* **1939.**—When certain powdered insulating materials such as SiO_2 are allowed to fall down a tube and strike a perforated metal plate or gauze of Zn, Cu, Ni or Fe, the metal plate becomes electrified positively and the powder negatively. The powder must have grains of nearly equal size and be perfectly dry. The electrification appears to be due to impact, not friction.

PA-42-2632

F-8. Fletcher, N. H.

"The Physics of Rain Clouds," Cambridge University Press (1962).

F-9. Forrest, J. S.

3423. Methods of increasing the electrical conductivity of surfaces. J. S. Forrest. *Brit. J. appl. Phys. Suppl. No.* **2 [***Static electrification***] S 37–S 39 (1953).**

Difficulties due to electrostatic charges on insulating surfaces can be overcome by coating the surface with an electrically-conducting film. The paper describes conducing films of metallic oxides, metals, carbon, moisture and wetting agents. Information is also given on the application of these films to ceramic and plastic insulating materials. PA-57-3423

F-10. Foster, W. W.

8324 **DEPOSITION OF UNIPOLAR CHARGED AEROSOL PARTICLES BY MUTUAL REPULSION.** W.W.Foster. Brit. J. appl. Phys., Vol. 10, No. 5, 206-13 (May, 1959).

A simple theory is developed. The application enables the average radius and the average charge of the particles to be determined from measurements of the mass of smoke deposited on metal surfaces and the charge given up by the particles. This new method offers a means of determining the rate of coagulation of unipolar charged aerosols. Experiments with wood smokes indicate that the simple theory of deposition is correct. The calculated average radius of the wood smoke particles examined compares favourably with that determined from measurement of the optical density and mass concentration of the smoke. The charge determined by the new method is consistent with that calculated on the basis of corona charging theory. PA 63-8324

F-11. Fraas, F.

"Electrostatic Separation of High Conductivity Minerals," U.S. Dept. Interior, Bur. Mines, RI 6404 (1964).

F-12. Fraas, F.

"Electrostatic Separation of Granular Materials," U.S. Dept. Interior, Bureau of Mines, Bull. 603 (1962).

F-13. Fraas, F., and O. C. Ralston

"Distribution of Charge in Electrostatic Separation," AIEE Tech. Paper 51-202 (1951).

F-14. Franck, S.

2288. Dust Motion in Electric Fields. S. Franck. *Phys. Zeits.* **34.** *pp.* **214–218,** *March* **1, 1933.**—Using lycopodium and sugar dust the author has examined the forms taken by the dust when subjected to homogeneous and inhomogeneous electric fields, and a series of photographs is reproduced. PA-36-2288

F-15. Fraser, D. A.

"The Collection of Submicron Particles by Electrostatic Precipitation," Am. Ind. Hygiene Assoc. Quarterly 17, 1 (March 1956).

F-16. Frenkel, Ya. I.

566. Mechanism of the electrification of solids and liquids by atomization. Frenkel, Y. I. *J. Exp. Theor. Phys., USSR,* **18,** 799–806 (*Sept.,* 1948) *In Russian.*—The electrification of solid bodies (ionic dielectrics) by atomization may be explained by the selective effect in the formation of ionic holes of one of the two possible signs (whose formation requires less energy) on the surface of the crystal. Simultaneously the holes of the opposite sign form a space (diffuse) layer of electrification. The potential jump in this double layer balances the energy difference of hole formation of the ions of different signs. When a substance is atomized, the particles take a charge of the same sign as the original surface. With an increase of the dimensions of the particles their specific charge is correspondingly reduced, and under the influence of a supporting air current a separation of the lighter particles from the heavier ones takes place, which is also a separation of particles of

F-16. (Continued)

unequal charge. Thereby strong electric fields of the order of 1 000 V/cm are set up. The electroballistic effect, i.e. the charging up of water droplets by spraying, may be explained analogously.

PA 52-566

F-17. Frenkel, Ya. I.

Adsorption and discharge of free ions on the surface of colloid particles and its effect on the ionization and electrification of the atmospheric air. Ya. I. Frenkel. *Bull. acad. sci. U.R.S.S., Sér. geograph. geophys.* 9, 179-93 (1945).

CA 41-637g

F-18. Frenkel, Ya. I., and E. M. Fradkina

Translation available from SLA (John Crerar Library), Number RT-1545.

Electrical parameters of disperse systems. Ya. I. Frenkel and E. M. Fradkina. *Kolloid. Zhur.* 10, 241-4 (1948);

CA-43-7776h

F-19. Frisch, H. L.

2333* The Diffusion-Controlled Growth of an Aerosol in a Turbulent Medium. H. L. Frisch. *Journal of Meteorology*, v. 11, Aug. 1954, p. 270-275.
Mathematical analysis. Graph. 9 ref. BMI 4-2333

F-20. Frumkin, A., and A. Obrutschewa

1987. Ballo-Electric Phenomena and the Potential Difference at the Surface of Separation between Gas and Solution. A. Frumkin and A. Obrutschewa. *Kolloid Zeits.* 54. *pp.* 2-7. *Jan.*, 1931.—The spraying of liquids leads to a separation of opposite electric charges, a phenomenon named water-dropping or bubble electricity and, by Christiansen, ballo-electricity. The present authors do not wish to develop a complete theory of ballo-electricity, but wish merely to investigate and consider solutions containing, side by side, capillary inactive electrolytes and capillary active non-electrolytes. It is deduced with few exceptions that the ballo-electrical capacity of different molecules is dependent on the type of their orientation at the surface of separation. The different compounds can be divided into two classes (the hyperkataballic and hyperanaballic bodies of Christiansen) depending on whether the positive end of the molecule in the surface of separation is directed towards the gas phase or towards the liquid phase. Water must be considered as belonging to the second class. PA-34-1987

F-21. Fuchs, N. A.

Fuks, N. A.
PRECIPITATION OF AEROSOLS ON VERTICAL SURFACES (Osazhdeniye Aerozoley na Vertikal'nykh Poverkhnostiakh). 4 Oct 60, 9p. (1 fig. omitted) 3 refs. Trans. V-1619.
Order from LC or SLA mi$1.80, ph$1.80 61-13803

Trans. of mono. Aerozoli v Sel'skom Khozyaystve, Moscow, 1956, p. 77-81.

The mechanism of aerosol precipitation on vertical surfaces is analyzed in an attempt to improve insecticidal wall spraying. Unipolarly infected (sic) aerosols are recommended because they disseminate evenly in all directions by their own priming and they sediment evenly on the ceiling, walls, and bottom of the chambers. A compact mobile device must be constructed and mounted on an aersol generator to obtain a unipolar corona discharge working from the light network. A low capacity generator must be invented to produce a mist of 5 to 10 micron particles. T5-310

F-22. Fuchs, N. A.

FUCHS, N. A.
ASLIB-GB-80. The magnitude of electric charges carried by particles of atmospheric aerosols. Izvest. Akad. Nauk Ser. Geofiz., 11, no.4, p.341-348, 1947.

TM 4-495

F-23. Fuchs, N. A.

Fuks, N. A.
THE MECHANICS OF AEROSOLS, tr. by E. Lachowicz. 1958 [457]p. 581 refs. CWL Special Pub. 4-12.
Order from OTS $7.50 59-21069

Trans. of [Mekhanika Aerozoley] Moscow, 1955.

Contents:
Classification of aerosols. Dimensions and shape of particles in aerosols
Rectilinear, uniform motion of aerosol particles
Rectilinear irregular motion of aerosol particles
Curvilinear motion of aerosol particles
Brownian movement and diffusion in aerosols
Convective and turbulent diffusion in aerosols
Coagulation of aerosols
Transformation of powdery substances into the aerosol stage T3-152

F-24. Fuchs, N. A.

"On the Stationary Charge Distribution on Aerosol Particles in a Bipolar Ionic Atmosphere," Geofisica Pura E Applicata 56, p. 185 (1963/III).

Summary — By the «limiting sphere» method the combination coefficients for gaseous ions and aerosol particles were calculated, allowing for the jump in ion concentration at the surface of the particles. Hence the stationary charge distribution on aerosol particles in a symmetrical bipolar ionic atmosphere was determined. The use of the Boltzmann equation for this purpose proposed by some authors is theoretically wrong as *this equation applies to equilibrium rather than to stationary states.* In practice, the Boltzmann equation can be used for particles with radius $\geq 5 \cdot 10^{-5}$ cm (under atmospheric pressure). Within this range the image forces and the jump in ion concentration may be neglected. The conditions of the applicability of the steady diffusion equation to the theory of the stationary charge distribution in aerosols are discussed.

Author

F-25. Fuchs, N., and P. Lissowski

The charging of aerosols by ionic diffusion. N. Fuchs and P. Lissowski (Acad. Sci. U.S.S.R., Moscow). *J. Colloid Sci.* 11, 107–8(1956).

CA-50-6137h

F-26. Fuchs, N; I. Petryanov, and B. Rotzeig

"On the Rate of Charging of Droplets by an Ionic Current," Trans. Faraday Soc. 32, 1131-8 (April 1936)

1. A method for the determination of the rate of charging of floating particles by an ionic current is described. It consists of passing a narrow cloud-jet parallel to the axis of a cylindrical electric precipitator, and measuring the charges acquired by the particles in it.

2. The experiments were made with oil-droplets ranging from 0·5μ to 3μ radius. The size and charge of the droplets were measured by the "oscillation" method. Current densities of about 3 to 10 × 10^{-9} A/sq. cm. and times of charging of about 0·01 to 0·02 sec., were used.

3. A good agreement between the mean values of the measured charges and theoretical values calculated neglecting the effects due to diffusion of ions and to mirror-forces, was obtained for the whole range of sizes studied.

Author

F-27. Fukada, E., and J. F. Fowler

2290. TRIBOELECTRICITY AND ELECTRON TRAPS IN INSULATING MATERIALS: SOME CORRELATIONS.
E. Fukada and J. F. Fowler.
Nature (London), Vol. 181, 803-4 (March 8, 1958).

Ten different insulating materials have been tested for the polarity of electrification when rubbed against each other, and a sequence of increasing tendency towards negativity was established. A comparison with certain features of the electron trap distribution, as derived from measurements of X-ray-induced conductivity, indicates some correlation between these two properties of the materials.

PA-61-2290

F-28. Furman, A. M.

The mechanism of the electrification of artificial aerosols (smokes). A. M. Furman. *J. Tech. Phys.* (U.S.S.R.) 17, 111-14(1947)(in Russian)

CA-42-28h

F-29. Furuya, A., et al.

4616. The magnitude of charge of conduction particles moving in an a.c. field. A. FURUYA, S. SEKIGUCHI AND Y. HAYASHI. *J. Inst. Elect. Engrs Japan*, 73, *No.* 9, 984–9 (*Sept.*, 1953) In Japanese.

With regard to the separation of particles in an a.c. field, the magnitude of charge of the particle obtained by conduction from the lower plate is one of the most important conditions affecting the separation efficiency, yet this kind of charge has never been sufficiently discussed. With this in mind, the charge of a particle moving in the field was measured by means of a d.c. amplifying circuit of the type developed by L. A. Dubridge and H. Brown.

PA-58-4616

G-1. Gallily, I, and G. Ailam

"On the Vapor Pressure of Electrically Charged Drops." J. Chem. Phys. 36, 1781 (1962).

A general expression is derived for the vapor pressure of a charged drop situated at the center of a spherical container with perfectly reflecting wall. It is assumed that the liquid is conducting, the medium devoid of external fields of force and that the gaseous phase comprises both neutral and charged molecules. The vapor pressure in the case where the radius of the container is close to that of the drop was evaluated after solving the equation for the distribution of the charged molecules near the surface.

It was shown that, in general, the vapor pressure tends to increase with increasing distance from the drop let, thus rendering impossible the attainment of a thermodynamic equilibrium in the atmosphere. The vapor pressure of a charged aqueous droplet is given as a numerical example.

Author

G-2. Gavis, J.

"Transport of Electric Charge in Low Dielectric Constant Fluids." Chem. Engr. Sci. 19, 237-252 (1964).

Abstract—Electrokinetic phenomena in fluids have usually been described mathematically in terms of the electrical potential distribution within, and at the surfaces of the fluid. In this paper an alternative description of electrokinetic phenomena in terms of the charge distribution within the fluid and at its surfaces, applicable when the dielectric constant of the fluid is low, is given. This takes the form of a linear partial differential equation for the transport of electric charge by diffusion, conduction, and convection in the fluid. The principle of similarity is applied to the equation; types of electrokinetic phenomena to be expected in a given system are characterized in terms of two ratios of characteristic lengths, the Reynolds number, and the Schmidt number. Three examples in which the equation is solved, subject to appropriate boundary conditions, are presented. A comparison with previous work by the author on charge generation and transport in turbulent flow of hydrocarbons through tubes is made. The theory developed may be applied to electrokinetic problems in hydrocarbon systems and should be applicable to problems in atmospheric electricity.

Author

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G-3. Geist, J. M.

"An Electronic Spray Analyzer for Electrically Conducting Particles." PhD Thesis, Univ. Michigan, 1950.

The electronic spray analyzer incorporates a probe carrying a positive electrical potential, upon which the drops in a spray impinge. If the drops conduct electricity, pulses of negative potential occur in the probe. These pulses are amplified, sorted according to size, and counted.

The relationship between the particle size and the size of the pulse obtained at the input to the amplifier is apparently independent of the material of the drop so long as the material is a conductor. Metal spheres with diameters from 500 microns to 6340 microns and water drops with diameters from 2590 microns to 4550 microns followed the same calibration curve. For drops of material having relatively high conductivity the size of the pulse varied directly with the probe potential and approximately with the 1.6 power of the particle diameter, at least over a range from 1/2 to 6 times the diameter of the probe wire. The size of the pulse is also dependent upon the position of impact of the drop on the probe.

These characteristics of the probe are explained by considering the probe to act as a condenser with a fixed charge. The change in the capacitance of the probe due to the placement of a spherical conductor in contact with the probe creates a pulse of negative potential, dependent upon the electric field around the probe.

With further development of the geometry of the probe and of the electronic counter, the electronic spray analyzer may offer a rapid method for determining the drop size and size distribution in the spray of an operating nozzle with a minimum of error due to sampling.

Author

G-4. Gerson, R. and J. H. Rohrbaugh

"Experiments on the Carnauba Wax Electret." J. Chem. Phys. 23, No. 12, 2381 (Dec. 1955).

The strength of the applied electric field, the thickness of the slab being electrified, the time of electrification and the low temperature holding time before removing the field were varied for carnauba wax electrets. After approximately one hour the discharge current varied inversely as a power of the time since turning off the forming field, the power being close to one. The magnitude of this current depended on both the forming field strength and on the thickness of the electret. A very large discharge was obtained when the wax was electrified and discharged while not completely solid.

Dielectric constant measurements were made at temperatures between 27°C and 86°C, frequencies between 50 cps and 13 kc, and with superposed dc field strengths in the wax of zero, 3700 and 8100 volts per cm. The application of dc field was found to raise the dielectric constant at the higher temperatures.

The case for permanent dipole orientation and that for ionic space charges as the cause of the stored charge of the electret is examined, and it is shown that there are objections to each mechanism. An alternate explanation is suggested.

Author

G-5. Gilbert, H. W. and P. E. Shaw

2133. *Electrical Charges at a Liquid-gas Interface.* H. W. Gilbert and P. E. Shaw. (Phys. Soc., Proc. 37. pp. 195–213; Disc., 213–214, June, 1925.)—This paper is a general review and discussion of the various methods of studying the potential differences and electric charges which arise at a liquid-gas interface. The authors divide the subject into the following main headings: (*a*) The determination of the p.d. at the surface liquid-gas when one or both of these is at rest. (*b*) Cataphoresis of gas bubbles. (*c*) Passage of gas over a liquid without rupture of the latter, or of a gas over a wet solid with the same proviso. (*d*) The fall of a liquid in an unbroken column through a gas. (*e*) Liquid jets. (*f*) Waterfall electricity. (*g*) Electrification produced by bubbling gases through liquids. (*h*) Electrification produced by shattering drops in air-stream. (*i*) Electrification produced by spraying a liquid. An attempt is made to coordinate the material obtained from this vast area of research. Many of the results may be obtained in terms of the modern theory of orientation and polarisation of the liquid-gas interface, but there are other facts which do not appear to come within the scope of established principles. Suggestions are made as to possible developments in future research.

PA 28-2133

G-6. Gill, E. W. B.

3422. Electrification by freezing. E. W. B. GILL. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 16-S 18 (1953).

The high potentials of the order of 100 V developed when ice is formed from dilute solutions were investigated to discover the mechanism. Contact potentials between solids and liquids are usually of the order of 1 V and some further fact must operate to achieve 100 V. The theory suggested is that, whereas in the usual case the charges producing the potentials are adjacent to the boundary, in the case of freezing ice the charges extend to a small distance from this boundary. PA-57-4322

G-7. Gill, E. W. B.

3975. Frictional electrification of sand. GILL, E. W. B. *Nature, Lond.*, 162, 568-9 (*Oct.* 9, 1948).—By means of a simple experiment it is shown that the free fall of dry sand produces a potential of measurable magnitude. It is concluded that the sand rubbing on itself produces positive charges on the smallest particles and negative charges on the larger ones. This observation is believed to explain the build-up of high potentials in dust storms. PA-52-3975

G-8. Gill, E. W. B.

3974. Frictional electricity. GILL, E. W. B. Letter in *Phys. Rev.*, 74, 842-3 (*Oct.* 1, 1948).—Observations relating to charges produced on small insulating particles sliding down a metal funnel were given by Debeau [Abstr. 2598 (1944)] together with certain suggested explanations. It is now shown that the observed results admit of an alternative explanation in which the particles reach a sufficiently high potential to produce a discharge through the air round them. On this view the charge/air-pressure curve would resemble the well-known curve of sparking potential against pressure. The observation that the charge has a min. value at about 1 mm Hg pressure is thus accounted for. PA-52-3974

G-9. Gill, E. W. B. and G. F. Alfrey

6323. The electrification of liquid drops. E. W. B. GILL AND G. F. ALFREY. *Proc. Phys. Soc.* [*Lond.*] B, 65, 546-51 (*July*, 1952).

Charges on drops breaking up in electric fields were investigated and it was found they could all be explained by the ordinary laws of electrostatic induction, with allowance for contact potential differences. Electrification due to splashing was also studied and again the effects could be explained by contact potentials alone, so that theories of double layers put forward to explain previous experiments are unnecessary. A warning is given of the necessity of making due allowance for possible electrification by splashing in interpreting experimental results, and a critical examination of an experiment of Zeleny is reported. A few experiments of splashing water drops off ice gave results which may have a bearing on the production of electricity in thunderstorms PA-55-6323

G-10. Gill, E. W. B. and G. F. Alfrey

3563. Production of electric charges on water drops. E. W. B. GILL AND G. F. ALFREY. Letter in *Nature* [*Lond.*] 169, 203-4 (*Feb.* 2, 1952).

In contrast to earlier work [Abstr. 5802 (1950)] no considerable contact potentials are found to be developed at the water-ice interface during the freezing of dilute aqueous solutions. A tentative explanation is offered of the observed large potentials developed between water and ice. It is suggested that when a small water drop impinges on an ice particle a large negative charge is carried away by the rebounding water, a corresponding positive charge being left in the outer ice layers. If melting occurs the polarities may be reversed. PA-55-3563

G-11. Gill, E. W. B. and G. F. Alfrey

2437. Electrification of liquid drops. E. W. B. GILL AND G. F. ALFREY. Letter in *Nature, Lond.*, 164, 1003 (*Dec.* 10, 1949).

A jet of water falling vertically from an earthed metal reservoir was surrounded by an insulated metal cylinder which could be charged to various potentials V between $\pm 1\,000$ V. The charge Q per cm³ acquired by the water on breaking up into drops was found to be $\propto V$. The small value of Q remaining when $V = 0$ is attributed to contact potential difference between water and reservoir. In similar experiments with insulating liquids (CCl_4, transformer oil) an applied field had no effect. PA-53-2437

G-12. Gill, E. W. B. and G. F. Alfrey

5418. Frictional electrification. GILL, E. W. B. AND ALFREY, G. F. Letter in *Nature, Lond.*, 163, 172 (*Jan.* 29, 1949).—The frictional charges acquired by dielectrics such as ebonite and sand when sliding over an earth-connected inclined metal plane, are affected to a considerable extent when an external electric field is applied between the plate and another plate placed above and parallel to it. The charge, Q, is given by $Q = -AX - Q_0$, where X is the electric field (pos. or neg. according as the upper plate is pos. or neg.), A is a constant and Q_0 is the charge produced in zero field. With neg. fields, Q is reduced and can be made zero when $X = -Q_0/A$. These effects are of interest not only in throwing light on the mechanism of frictional electricity, but may be also of practical significance, since by applying an external field, the frictional charges may be so reduced that dangers resulting from frictional electrification are eliminated. PA-52-5418

G-13. Gillespie, T.

"Electric Charge Effects in Aerosol Particle Collision Phenomenon." pp. 44-49 of "Aerodynamics Capture of Particles - Proc. of Conf. at BCURA, Leatherhead, Surrey, England, 1960. Pergamon Press (1960)

G-11. Gillespie, T.

"The Role of Electric Forces in the Filtration of Aerosols By Fiber Filters." J. Coll. Sci., 10, 296-314 (June 1955)

G-15. Gillespie, T.

"On the Adhesion of Drops and Particles on Impact at Solid Surfaces:"
I. (Gillespie) pp. 266-280
II. T. Gillespie and E. Rideal pp. 281-298
J. Coll. Sci., 10, 266-298 (June 1955)

G-16. Gillespie, T.

4451. The effect of the electric charge distribution on the ageing of an aerosol. T. GILLESPIE. *Proc. Roy. Soc. A*, 216, 569-82 (*Feb.* 24, 1953).

Smoke-chamber experiments have been carried out to determine the electric charge distributions and the constants descriptive of coagulation and surface loss of aerosols of porous silica powder, magnesium oxide and ammonium chloride. The data obtained were used to test the hypothesis that the rate of coagulation is affected by the electric charge distribution. Calculations have been made of the effect of electric charge on the particles of an aerosol on its rate of coagulation due to Brownian movement, differences in gravitational settling and turbulence. A simple expression for the coagulation constant was obtained which was found to be a function of the fraction of positive particles, the fraction of negative particles, the average particle charge of each sign and the average radius. A more exact treatment of ageing data than has previously been presented indicated a possible variation in the coagulation and surface loss constants with time, and this variation has been shown to be related to changes in the electric charge distribution.

PA 56-4451

G-17. Gillespie, T. and G. O. Langstroth

2792. An instrument for determining the electric charge distribution in aerosols. T. GILLESPIE AND G. O. LANGSTROTH. *Canad. J. Chem.*, 30, 1056-68 (*Dec.*, 1952).

An instrument has been developed to permit measurement of the electric charges on a relatively large number of particles during a comparatively short period in the history of an aerosol. These novel characteristics have been obtained by depositing a sample on microscope slides in such a way that the charge on any particle at deposition can be determined in a subsequent examination from the size of the particle and its position on the slide. There is evidence to show that the act of sampling with this instrument does not cause spurious charging of particles. The construction and theory of the instrument are described in some detail and results of tests are given to show that the theory is applicable. The use of the instrument is illustrated by an account of a preliminary study of the charge distribution in a silica dust aerosol at various times after generation.

PA 56-2792

G-18. Gillespie, T. and G. O. Langstroth

Ca. J. Chem. 30, 1003-1011 (Dec. 1952)

COAGULATION AND DEPOSITION IN STILL AEROSOLS OF VARIOUS SOLIDS

Studies have been made of the aging of magnesium oxide, zinc oxide, carbon, copal resin, and silica powder aerosols, under essentially uniform experimental conditions. The changes with time in the particulate number and in the number of particles lost from the system by deposition on chamber surfaces are well described in terms of the coagulation constant k and the deposition constant β with the aid of equations known to be applicable to ammonium chloride aerosols over a wide range of conditions. Marked differences were found in the values of k for different aerosols and lesser differences in the values of β. An electron microscope study of the shape and structure of the particles led to the conclusion that differences in these characteristics are not predominantly responsible for the observed differences in behavior, although they may be a contributing factor. A few preliminary experiments in which silica powder was dispersed through an electrically charged screen indicated that the coagulation and deposition processes are influenced by changes in the electrical charge distribution.

Author

G-19. Glosios, T.

2162. Formation of Condensation Nuclei under the Influence of Electric Charges. T. Glosios. *Ann. d. Physik*, 34. 5. *pp.* 446–448, *March*, 1939.—It is shown that the theory of Tohmfor and Volmer [see Abstract 6003 (1938)] with certain refinements is in agreement with experiment without supposing that there is a decrease in the dielectric constant of a liquid in the form of drops.

PA-42-2162

G-20. Godard, L. and C. Lafargue

1068. On a procedure to measure the charges carried by fine electrified particles. L. GODARD AND C. LAFARGUE. *C.R. Acad. Sci., Paris*, 231, 786-7 (*Oct.* 16, 1950) *In French.*

The fine particles (raindrops, fog, snow crystals and aerosols) are trapped in a fluid of known viscosity (usually a silicone) between the plates of a parallel plate condenser. Their movement under a known potential difference is observed with a microscope and the charge calculated by the application of Stokes's law.

PA-54-1068

G-21. Göhlich, H.

"Investigations to Improve Precipitation of Plant Protectives by means of Electrical Charges." VDI-Forschungsheft No. 467, Supp. to Forsch. Geb. Ingenieurw. B 24 (1958), 32 pp

Plant protection of agricultural crops is mainly practised by deposition of chemical substances on the plant surfaces, these substances being bonded to solid or liquid carrier particles. Improved deposition effects can be achieved by applying electrostatic charging. Laboratory tests proved that charging results in a considerably better distribution of the particles and in a twofold to threefold increased precipitation. Further advantages consist in a reduced grade of dispersity of the deposed particles and in a stronger adherance of dust particles to the plant surfaces. Extended experiments revealed the most efficient arrangement of the electrostatic charging implements and the relations between spray current, density of dust or liquid particles, and charge of particles. Author

G-22. Goldin, D. S. and C. T. Norgren

"Thrust Measurements of Collodial Particles as an Indication of Particle Size and Thrustor Operation." AIAA Elec. Prop. Conf., Colorado Springs, Mar. 11-13, 1963. Paper No. 63050-63.

Thrust measurement and its correlation to the operational characteristics of an experimental colloidal-particle thrustor are discussed. Measurements were made on a previously designed condensation colloidal-particle electrostatic thrustor with mercurous chloride as the propellant. Thrust measurements of the order of 1 to 10 milligrams were made with a modified electric microbalance calibrated to a sensitivity of 10^{-4} to 10^{-5} gram. As anticipated from the classical liquid-drop theory of nucleation, no thrust was observed until a viscous flow regime and subsequently a critical nucleation rate had been obtained in the nozzle. This condition corresponds to a vaporizer temperature of 485° K. With the assumption of singly charged colloids, it was determined that a mean particle size of 1.2×10^6 amu would be required to account for measured target deflections at a vaporizer temperature of 450° K. From an electron photomicrograph of the colloidal beam at similar operating conditions, a mean particle size of 1.71×10^6 amu was indicated. Author

G-23. Gordieyeff, Y. A.

3175* Some Properties of Unipolarly Charged Aerosols. V. Alexander Gordieyeff. *Archives of Industrial Health*, v. 14, Nov. 1956, p. 471-481.

Theories and experimental work on charged atmospheric particles and physiological effects on the body.

BMI-6-3175

G-24. Gotsch, G.

"Untersuchungen Zum Problem Der Aktivität Kleiner Kondensationskerne." Arch. for Meterologie, Geophsik und Bioklimatologie, Series A, 13, 73-116 (1962).

The author describes experiments with mixed cloud and expansion chambers for the examination of the activity of Aitken nuclei and compares them with the theory of H. KÖHLER and CHR. JUNGE. He states that a supersaturation of about half a percent is sufficient to actuate most of the nuclei counted by means of an Aitken nucleus counter with an increase of volume of 25%. Since this theory requires a considerably higher supersaturation for actuating all Aitken nuclei, a correspondence between theory and results of measurements could not be found.

Further-on it could be demonstrated that with adiabatic expansion the released water vapour combines with the nuclei in approximately 100 millisec to such an extent that possibly not yet condensed free vapour is not detectable. This reaction is in first approximation independent of the expansion speed; with very rapid expansion the cloud is already traceable after 1—2 millisec. The extremely high speed of the condensation makes it probable that the supersaturations of the free atmosphere do not exceed 1‰, so that in the formation of natural clouds only that group is involved which is already actuated with such small supersaturation. The results of the experiments lead to the assumption that, contrary to the conception hitherto generally recognized, a very large quantity of the Aitken nuclei belongs to this highly active group of nuclei. Author

G-25. Gott, J. P.

4118. Movements of Electrically Charged Cloud Particles. J. P. Gott. *Cambridge Phil. Soc., Proc.* 32. *pp.* 486–492, *July*, 1936.—Experiments are described in which observations were made of the motion of electrically charged cloud particles past a sphere. The cloud particles were moving vertically in an air stream, and there was a vertical electric field. This gave conditions similar to those surrounding a falling rain drop in a thundercloud, and the observations are in accordance with the theory proposed by Wilson to account for the mechanism of thunderclouds.

PA-39-4118

G-26. Gott, J. P.

4931. Charge on Water Drops Falling through a Cloud of Charged Particles in a Vertical Electric Field. J. P. Gott. *Roy. Soc., Proc.* 151*A*. *pp.* 665–681, *Oct.* 1, 1935.—A preliminary part of the work consisted in developing methods for producing a cloud by cooling a mixture of steam and air, of giving the cloud a charge by exposure to ionisation in an electric field, and of producing a cloud containing equal numbers of + and — particles, by mixing two clouds carrying charges of opposite signs. This was followed by the measurement of the electrical conductivity of the cloud, and of other quantities related to it. The mobility of an individual cloud particle in strong electric fields was found to be less than the velocity of a falling water-drop. Measurements were made of the charge collected by a large water-drop while falling through a jet of the cloud containing equal numbers of + and — particles in a vertical electric field between two horizontal plates. When the upper plate was + the drop collected a — charge, and when the upper plate was — the drop collected a + charge. This is in agreement with a theory proposed by Wilson in connection with the mechanism of thunder-clouds. The quantitative agreement is as close as could be expected from the experimental arrangements. The experiments also afforded a test of the mechanism suggested by Elster and Geitel; any charge thus collected was too small to be observed. PA-38-4931

G-27. Gott, J. P.

1257. Splashing of Water in an Electric Field. *J. P. Gott. Cambridge Phil. Soc., Proc.* 31. *pp.* 85-93, *Jan.*, 1935.—A detailed account is given of the appearances observed when drops of water 1·6–2·6 mm. radius, fall from various heights > 120 cm., into deep water under the influence of a vertical electric field of varying strength > about ± 6300 V/cm. The smallest drops in the spray thrown up by a splash just begin to rise towards the upper plate in fields of about 300 V/cm., *i.e.* slightly > the field observed at the earth's surface in a thunderstorm. The charge of such a drop is of the order 1000 e.s.u./cc., and its radius < about 0·5 mm. PA-38-1257

G-28. Gott, J. P.

4837. Electric Charge Collected by Water Drops falling through Ionised Air in a Vertical Electric Field. *J. P. Gott. Roy. Soc., Proc.* 142. *pp.* 348-366, *Oct.* 2, 1933.—Three series of experiments have been made to determine the charge collected by a water drop falling in a vertical field through air ionised by a beam of X-rays, different forms of ionisation being produced in the three cases. It was found that (1) in the presence of ions of one sign only rising up to meet the falling drop, it collects a charge for all values of the electric field; (2) when ions of one sign only are moving down in the same direction as the drop falls, the charge collected depends on the velocities of the drop and the ions; and (3) if the descending ions have the greater velocity, so that they overtake the drop, then it collects a charge, but if the drop has the greater velocity, so that the descending ions cannot overtake it, then it collects no charge. The electric field which gives to the descending ions a velocity equal to that of the drop is the critical field for the phenomenon. In the presence of ions of both signs, carrying equal currents, the drop collects no nett charge in fields greater than the critical field. In fields less than the critical field it collects more ascending than descending ions and so gains a nett charge. This charge does not increase indefinitely, but tends to a limiting value. Experiments have been made with one size of drop only. In fields greater than the critical field, the initial rate at which the drop collects charge in the presence of ions of one sign only is equivalent to collecting the ionisation current from an area equal to three times the area of cross section of the drop. This applies both for ascending and descending ions. In fields less than the critical field, the initial rate at which the drop collects charge from ascending ions appeared, in the experiments, to be different from this value, but the difference may not be a true effect. In the experiments the drop was not distorted from the spherical shape. These experimental results are in accordance with the theory proposed by C. T. R. Wilson to account for the mechanism of thunderstorms and the electric charge brought down by rain. [See Abstract 280 (1930) respectively.] PA-36-4837

G-29. Goudet, G. and P. Laurenceau

17859 STUDY OF THE TRIBOELECTRIC PROPERTIES OF VARIOUS SYNTHETIC FABRICS.

G Goudet and P.Laurenceau.
J. Phys. Radium (France), Vol. 21, Suppl. No. 7, 87A-91A
(July, 1960). In French.

A method of measuring charges due to friction caused by knitted synthetic fibres is described, as well as the corresponding apparatus. The method chosen makes it possible to obtain fairly accurate and reproducible results. Two sets of experiments illustrate the application, one examining comparatively the triboelectric properties of knitted polyvinylchloride and acrylonitrile, the other studying the behaviour of knitted polyvinylchloride tubes loaded with CaF_2 in different amounts. Charts indicate how the different knitted materials might be classified, according to their composition.

PA-64-17859

G-30. Goyer, G. G., R. Gruen, V. K. LaMer

7828. Filtration of monodisperse electrically charged aerosols. G. G. Goyer, R. Gruen and V. K. LaMer. *J. phys. Chem.*, 58, 137–42 (*Feb.*, 1954).

Uniform particle size liquid aerosols were charged electrically by passage through a wire to cylinder corona discharge. The unipolar droplets carried a positive charge ranging from 25 to 150 electronic charges depending on the intensity of the charging field (5–18 e.s.u.) and the radius of the aerosol droplets (0·25–0·55 μ). Charge and radius were determined with a Millikan-type oil drop apparatus. The maximum theoretical charge was not obtained and a distribution of charge on uniform particle size particles was observed. Factors affecting the incompleteness and non-uniformity of charge are: electric winds, turbulent flow, non-uniform velocity of flow and charging times, inhomogeneity of the field gradient. Although a completely uniform charge was not obtained, a sufficiently well defined charge range was obtained for the particle radii studied, to yield reproducible filtration at a given size as a function of the average particle charge. Filtration of charged dioctyl phthalate monodisperse aerosol droplets through Chemical Corps No. 5 filters was studied at two linear velocities, 2·7 and 28 cm/sec. An appreciable decrease in penetration is observed upon charging. As would be expected, this decrease is larger at smaller linear velocities. The time of transit of the charged particles through the filter layer is an important factor. The effect of charges on filter penetration is larger the smaller the droplet size.

PA 57-7828

G-31. Graf, P. E.

"Breakup of Small Liquid Volumes by Electrical Charging." API Res. Conf. on Distillate Fuel Combustion Conference Paper CP-62-4. June 19-20, 1962, Chicago.

Atomization of organic liquids can be produced by electrical charging. This results from the pressure developed by the mutual repulsion of surface charges. When the electrical pressure exceeds a critical value determined by the drop's surface tension and radius, the surface becomes unstable and a liquid jet is ejected. A dispersion of fine droplets is obtained as the jet breaks up.

Electrical pressure, P_e, can be calculated from

$$P_e = F \frac{V^2}{8\pi r^2}$$

where V is the applied voltage, r is the drop radius, and F is a charging factor. The charging factor, which represents the fraction of the applied potential attained on the drop surface, decreases with increasing liquid conductivity and increasing electrode spacing. The electrical pressure is largely independent of the charging electrode's configuration and polarity and of the liquid's dielectric constant. A charging mechanism is discussed in terms of ion migration in an electrical field. The rate of charging determines the continuity of jet ejection and the quality of atomization. High charging rates are obtained with (1) high liquid conductivity, (2) large charging electrode surface, and (3) high potential gradient.

Author

G-32. Green, H. L. and W. R. Lane

"Particulate Clouds: Dusts, Smokes and Mists, their Physics and Physical Chemistry and Industrial and Environmental Aspects." Spon, London, 1957.

G-33. Grenet, G.

"Note on the Electrostatic Phenomena Capable of Acting upon Frosting." (In English) Bull. du CRA 3, 45 (1946).

G-34. Griffin, C. W., et al

5481* Studies of Aerosols With a Simple Cloud-Chamber Technic. I. The Evaluation of a Technic for the Rapid and Convenient Determination of the Survival of Air-Borne Microorganisms. Charles W. Griffin, H. Lucille Kantzes, Pamela M. Ludford, and Michael J. Pelczar. *Applied Microbiology*, v. 4, Jan. 1956, p. 17-20.

Syringe-dilution and slit-sampler techniques were evaluated as to their relative accuracy and dependability, ease and speed of performance, and their adaptability to the study of a number of conditions. Photograph, graph. 10 ref. BMI 5-5481

G-35. Gross, B. and R. J. de Novaes

"Polarization of the Electret." J. Chem. Phys. 37, No. 4, 710-713 (15 Aug. 1962).

The internal charge distribution of the carnauba wax electret has been determined by a sectioning method: After polarization and cooling samples are cut into sections of different thickness. These are relaxated and the ensuing discharge currents are measured. The total released charge, as determined by numerical integration of the corresponding current-time curve, gives the polarization of each section. A macroscopic space charge polarization would give charge values which, with decreasing thickness of sections, go to zero; a uniform volume polarization would give values which are independent of thickness. Measurements gave constant values and therefore prove the existence of a uniform volume polarization of the electret.

Author

G-36. Groszteinbeck, R., H. Holte, and W. Tullius

"Paint Media in Electrostatic Spraying." (In English) Farbe und Lack 65, No. 6, 303 (1959).

In electrostatic spraying, drop size and velocity affect the quality of the paint coating while the spray angles provide an indication of the ability of the paint to reach all surfaces of the work presented to the spray. The Authors feel, therefore, that when the composition is known, measurements of the conductivity or dielectric constant of the paint can provide some indication of its probable behaviour in electrostatic spraying.

Author

G-37. Gubkin, A. N.

"The Phenomenological Theory of Electrets." Zh Tekh Fiz. 27, No. 9, 1954-68 (1957). [Soviet Physics- Tech. Phys. 2, No. 9, 1813-24 (Sept. 1957)]

Adams' and Swann's phenomenological theories were developed for short-circuited electrets. It is shown that only when short-circuiting is allowed for can the phenomenological theory give results describing the experimental data for electrets made from Carnauba wax correctly. The theory developed here is also extended to new electrets made from inorganic insulators with electrical conductivities considerably higher than that of Carnauba wax. The analysis shows that the electret lifetime can be defined as $1/4\pi M$, where M mainly depends on the electret conductivity, the surrounding medium and the short-circuiting conditions, and on $1/\alpha$, where α is a parameter specifying the time rate of fall of the semiconstant polarization. The values of $1/4\pi M$ and $1/\alpha$ are calculated for several electrets, as are the hetero- and homocharge magnitudes. It is shown that in most cases the electret lifetime is determined by $1/4\pi M$.

Author

G-38. Guest, P. G.

"Static Electricity in Nature and Industry." U. S. Bur. Mines, Bull. 368 (1933).

G-39. Gugan, K, J. Lawton and F. J. Weinberg

"The Response of Droplets and Particles to Electric Fields, in the presence of Ions."
Preprint: Tenth Symposium (International) on Combustion; Cambridge, England, 17 Aug. to 21 August 1964.

A theoretical study of the motion of charged molecular clusters, droplets, and particles is particles is presented as an essential part of an investigation into electrical control of certain combustion processes. The information required is the charge and mobility of each such charge-carrier, in the presence of flame-ions, under the influence of large fields. The study is subdivided by particle size and by whether the particles are charged to a constant level, or are free to continue acquiring charge along their trajectories in a field. Subdivision by size follows the response to molecular collisions. For the smallest, the target area for impact is greater than geometrical, because of dipoles induced in neighboring molecules. In the next size range, such forces of attraction are negligible, while interaction with neutral gas can still be treated as individual collisions. Larger particles experience such collisions only as a viscosity—leading into the Stokes regime. Lastly, particles of sufficiently large Re are treated in terms of Newton's Law ...d it is shown that this regime includes the largest sizes likely to be encountered in practice. Particles carrying constant charge occur when, after a region of relatively plentiful space charge (corona discharge, flame) their trajectories lie where no smaller charge carriers exist, or where the theoretical equilibrium charge is no greater than initial. The mechanisms and rates of charging due to ion bombardment, diffusion, and thermionic emission are next examined and it is shown that in the most relevant case—the drifting of particles towards electrodes in the company of ions—the particles' charge, together with field intensity tends to increase continuously.

The conclusions are analytical expressions for charge, mobility, and range of applicability for each combination of regimes. One noteworthy result is that the largest particles, when free to acquire charge, attain a constant mobility >5% of that of H_3O^+ Author

47

G-40. Gunn, R.

"Laboratory Substandard for the Production of Small Electrostatic Charges." Rev. Sci. Inst. 35, No. 7, 867-9 (July 1964).

An apparatus for conveniently producing discrete and transportable free electrical charges of magnitude from 0.01 to 10 esu of either sign is described. A known electric field intensity E is established between two horizontal parallel plates by a battery and a voltmeter. Steel balls of radius a are suspended from the mid ile of the upper plate by an electromagnet, allowed to fall freely through a hole in the bottom plate, and thence into a Faraday cage or other apparatus. The free charge Q induced on and carried by each ball is estimated from $Q=\frac{1}{2}\pi^2 Ka^2E$ esu, where K is an apparatus constant closely approximating unity. Deviations due to contact potentials are always clearly evident, but by averaging the values for positive and negative electric fields, one may approximately determine the superposed charges due to contact potentials. These may then be applied as a correction to the above equation. The present accuracy is capable of improvement by gold- or chromium-plating the metal parts to reduce contact electromotive forces.

Author

G-41. Gunn, R.

3968. ELECTRIFICATION OF AEROSOLS BY IONIC DIFFUSION. R.Gunn.
Amer. J. Phys., Vol. 25, No. 8, 542-6 (Nov., 1957).

The distribution of free electrical charges transferred to cloud droplets by ionic diffusion provides an example of a simple statistical process. Tables are constructed from first principles, shown to agree with successive terms of the binomial point equation of statistics, and applied to the initial stages of droplet electrification. The final equilibrium distribution, described by the basic electrification equation for aerosols, corresponds to an equipartition between the electrostatic energy of the droplets and their thermal kinetic energy. PA-61-3968

G-42. Gunn, R.

J. Colloid Sci. 11, 691-6 (1956).

THE RATIO OF THE POSITIVE AND NEGATIVE LIGHT ION CONDUCTIVITIES WITHIN A NEUTRAL AEROSOL SPACE

The diffusion of atmospheric ions onto an aerosol establishes a distribution of particle charges that depends on the ratio of the positive and negative light ion conductivities. When the aerosol space is electrically neutral, it is shown that this important ratio may be expressed in terms of the number of particles per unit volume, their size, the rate of ion pair formation, the light ion mobilities, and recombination coefficient. The derived relation is useful in defining the properties of an aerosol in terms of known and measurable atomic and electrical parameters.

Author

G-43. Gunn, R.

9116. RAINDROP ELECTRIFICATION BY THE ASSOCIATION OF RANDOMLY CHARGED CLOUD DROPLETS.
R.Gunn.
J. Meteorol., Vol. 12, No. 6, 562-8 (Dec., 1955).

Light ions generated in the atmosphere by cosmic rays and radioactivity normally diffuse on to cloud droplets and establish a nearly symmetrical Gaussian distribution of positively and negatively charged droplets. When the cloud becomes unstable, these cloud elements grow by association and the charges accumulate to establish a new equilibrium consisting of nearly equal numbers of larger and highly charged positive and negative cloud droplets. Growing raindrops or graupel falling through such a cloud are accordingly bombarded by both positive and negative droplets, and this establishes a statistical accumulated charge on the various drops. The distribution of the number of drops in relation to the sign and magnitude of the free charge is worked out from basic principles and shown to agree remarkably well with the magnitude and distribution of drop charges measured inside precipitating clouds. The mean drop charge, irrespective of sign, depends on the square root of the drop size and kinetic energy of the small droplets relative to the larger moving drops. An equipartition is established between the electrical potential energy carried by the larger drops and the relative kinetic energy of the smaller drops. The estimated drop charges on warm rain or graupel are sufficiently large to account for thunderstorm phenomena, provided only that some unspecified process systematically separates the positively and negatively charged drops. The charges produced at the rain forming level commonly approximate 50 electrostatic units per gram. The observed electrification of quietly falling rain is primarily a manifestation of the ionization produced in the atmosphere by radioactivity and cosmic rays. PA-59-9116

G-44. Gunn, R.

8522. DROPLET-ELECTRIFICATION PROCESSES AND COAGULATION IN STABLE AND UNSTABLE CLOUDS. R. Gunn.
J. Meteorol., Vol. 12, No. 6, 511-18 (Dec., 1955).

The fundamental electromechanics of droplet electrification and coagulation within stable and unstable clouds is investigated. The analysis shows that atmospheric ions formed by cosmic rays or other means normally diffuse on to cloud droplet and electrify them. A nearly Gaussian distribution is established in which about half of the droplets in any selected volume of a stable cloud acquire a positive charge that is typically eleven electronic units, while the other half is negative. More than 99% of the droplets of a typical cloud are electrified. When droplet association is negligible, an equipartition is established between the thermal kinetic energy of the droplets and their electrical potential energy. In an unstable cloud, these electrified droplets mechanically associate by relative motion in the gravitational field. Thus, the growing droplets accumulate charge and a statistical distribution of highly charged droplets is established. Expressions are derived for the distribution and for the mean statistical charge on the associated droplets. Equal numbers of positive and negative droplets are normally produced, but systematic charging due to unequal ionic conductivities sometimes results in marked electrification of a single sign. The influence of droplet electrification upon cloud stability is considered. The droplet charges normally have a detectable, but not important, direct effect upon the coagulation rate of the cloud. The indirect effects, however, may be large. Electric fields of appreciable magnitude always accompany precipitation as a result of drop-charge separation. Expressions are derived for the electrical coagulation of clouds immersed in an electrical field. It is shown that electrical coagulation may exceed that due to gravitation whenever the environmental electric field is 2 statvolts per centimetre or larger. Since fields this large are commonly observed in thunderstorms, the resulting precipitation rates are correspondingly large. PA-59- 8522

G-45. Gunn, R.

5050. The statistical electrification of aerosols by ionic diffusion. R. Gunn. *J. Colloid Sci.*, **10**, *No.* 1, 107–19 (*Feb.*, 1955).

A quantitative investigation of the diffusion of atmospheric ions on to spherical particles is reported. Special emphasis is given to random charging processes. The analysis shows that in typical cases about half of the particles are positively charged and the other half negatively charged. Nearly every particle carries at least one electronic charge and some twenty or more. Expressions are developed for the statistical distribution of the fractional number of droplets in relation to their charge. When particle collisions are infrequent, the average free charge of the positive and negative fractions depends only on the square root of the radius and the mean thermal energy of each droplet. It is shown that an equipartition is established between the electrical potential energy of each drop and its thermal kinetic energy. Typical particle electrification somewhat increases the coagulation rate normally attributable to diffusion alone. Systematic droplet electrification of a selected sign is superimposed on this random charging if the positive and negative light ion conductivities of the environment have appreciably different values. The calculated distribution and average charge magnitude agree with those observed on silica dust and new measurements on cloud particles PA-58-5050

G-46. Gunn, R.

1401. Diffusion charging of atmospheric droplets by ions, and the resulting combination coefficients. R. Gunn. *J. Meteorol.*, **11**, *No.* 5, 339–47 (*Oct.*, 1954).

The role of ionic diffusion in electrically charging drops in the atmosphere is investigated. Space charge and chemical adsorption being neglected, exact expressions are obtained for the charging rate and the average equilibrium charge acquired by a drop in an ionized atmosphere. The augmentation of the charge by appreciable relative motion is determined. The combination coefficients for neutral and charged droplets are calculated and found to agree with direct measurements. It is concluded that ionic diffusion plays a vital role in determining the electrical equilibrium in the atmosphere. PA-58-1401

G-47. Gunn, R.

"Measurements of the Electricity Carried by Precipitation Particles." Byers, H. R. (Ed.) "Thunderstorm Electricity" Univ. of Chicago Press, Chicago, 1953. pp. 193–206.

G-48. Gunn, R.

8371. The free electrical charge on precipitation inside an active thunderstorm. R. Gunn. *J. Geophys. Res.*, **55**, 171–8 (*June*, 1950).

The free electrical charges carried on individual precipitation particles were measured in an electrically active thunder-cloud at various altitudes up to 20 000 ft, using an aircraft and an improved induction method of measurement that avoided touching the particles. Data are given for the free electrical charge measured on the droplets and for the droplet space-charge density at 7 different levels. Positive and negative charges were usually encountered at all levels, but sometimes only a single sign was observed in a specific area. With the freezing level at 14 000 ft, the maximum electrification occurred near 7 500 ft and at a temperature of + 10°c. Here both the positive and negative charge approximated 0·27 e.s.u. per drop. The charge per drop at 5 000 and at 20 000 ft was less than one-fourth of this value. The electric field at the surface of the observed highly-charged droplets is a large fraction of the dielectric strength of air, showing that powerful electrifying agencies exist. The distribution of free charge inside an active thunder-cloud is relatively complicated.

PA-53-8371

G-49. Gunn, R.

6617. The free electrical charge on thunderstorm rain and its relation to droplet size. GUNN, R. *J. Geophys. Res.*, 54, 57–63 (*March*, 1949).—By means of a novel piece of apparatus, which is briefly described, simultaneous measurements are made of the free electrical charge and the mass of individual large rain-drops falling from thunderclouds. Values obtained in 3 storms are plotted and a definite tendency is found to exist for the charge to increase with the size of the drop. The average free charge is found to be 0·015 e.s.u. for a positive drop and 0·019 e.s.u. for a negative drop. Frequent changes are found to occur in the polarity of falling drops such that after 2 drops of one polarity have fallen there exists a high probability for the next drop to have opposite polarity. PA-52-6617

G-50. Gunn, R.

The electrical charge on precipitation at various altitudes and its relation to thunderstorms. GUNN, R. *Phys. Rev.*, 71, 181–6 (*Feb.* 1, 1947).—The free electrical charges on individual precipitation particles were measured by an induction method that avoided touching them. In a weak cold front exhibiting no thunderstorm activity, positive charges averaging 0·033 e.s.u. were observed from 10 000 to 26 000 ft. Negative charges averaging 0·04 e.s.u. were measured from the surface up to 20 000 ft. The electric field at the surface of many of the particles was an appreciable fraction of the breakdown field for air, showing that powerful electrifying agencies exist even under rather quiet frontal conditions. Electric field measurements showed that the particle charges were largely neutralized by nearby charges; the removal of this will immediately produce thunderstorm electric fields and potentials. PA-50-1079

G-51. Gunn, R.

2951. Electricity of Rain and Thunderstorms. R. Gunn. *Terr. Mag.* 40. *pp.* 79–106, *March*, 1936.—Following an introduction dealing with the factors which influence the distribution of free charge the author discusses first the electricity of rain. There it is shown that if each water droplet and the moisture laden atmospheric ions surrounding it be assumed to constitute an electric concentration cell then the observed properties of raindrops having different life histories can easily be described. The charges so calculated are found to be in agreement with observation. The next section dealing with a theory of thunderstorm electricity, shows that with a rapidly rising air current and with the formation of rain drops above a critical size separation of charge takes place. The charge distribution arising from the separation is calculated and agreement obtained with observation as regards potential difference, electrical field, etc. The author proceeds to show that special thunderstorm conditions in mountainous regions would maintain the earth's charge by bringing down sufficient negative charge on rain and transferring positive charge upwards. It is further considered that forced vertical convection over mountain barriers in fair weather may also contribute towards this end. PA-38-2951

G-52. Gunn, R. and C. Devin, Jr.

6120. Raindrop charge and electric field in active thunderstorms. R. GUNN AND C. DEVIN, JR. *J. Meteorol.*, 10, 279–84 (*Aug.*, 1953).

The electrical characteristics of two active spring thunderstorms are reported. Simultaneous surface measurements of the sign and magnitude of the free charge on individual raindrops, the electric field and precipitation rate have been made. More than 7000 drops, representing a continuous sample of the drops falling in the storms, show no important systematic dependence on the sign or magnitude of the instantaneous electric field. The measurements show that the convected current to the earth frequently exceeds the conduction currents by a large factor, and, therefore, the charged rain may determine the electric field at the surface. The average measured free charge brought down by positively charged rain was 0·022 e.s.u., and by negatively charged rain was 0·031 e.s.u. per drop. The ratio of the negative free charge to the positive free charge brought down by rain was 1·2, while the ratio of the number of negative drops to the number of positive drops was 0·88. PA-57-6180

G-53. Gunn, R. and R. H. Woessner

"Measurements of the Systematic Electrification of Aerosols," J. Colloid Sci 11, 254-9 (1956).

The distribution of the fractional numbers of aerosol particles carrying assigned charges was measured for the case where the positive and negative light ion conductivities of the environment were *unequal*. The maximum of the distribution is displaced toward the sign of the charge that corresponds to the ion having the predominant conductivity. With a measured ratio of $\lambda_+/\lambda_- = 0.8$; about 95% of the particles carried negative charges and had an average value of $-12e$. The magnitude of both the observed mean charge and the distribution corresponds closely to the *aerosol electrification equation* recently worked out by the senior author. The investigations show that ionic diffusion is responsible for the equilibrium electrification of perhaps most aerosols.

Author

G-54. Güntherschulze, A.

1633. *A Reply to the Paper by Busch: The Potential Gradient in the Vicinity of a Thin Wire.* A. Güntherschulze. (Zeits. f. Physik, 36. 3. p. 193, 1926.)—The author commences his reply by admitting the validity of Busch's standpoint, and then states that his previous work on electronic orbits has for objective the derivation of a simple formula which would permit a judgment of the phenomena discovered by Katsch [see Abstract 2140 (1925)]. He points out that his formula, obtained by certain simplifications, is not a rough approximation as stated by Busch, but that while strictly valid only for an infinitely thin kathode wire, its deviations for finite wires increase with their thickness as compared with the dimensions of the apparatus. PA-29-1633

G-55. Gutmann, F.

"The Electret"
Rev. Mod. Phys. 20, No. 3, 457-72 (July 1948).

H-1. Haase, H. and B. H. Hardtke

"Effect of Electrostatic Charges Upon the Behavior of Dust Systems," Chem. Ing. Tech. 29, 814-816 (1957).

H-2. Hall, W. C.

"Electrostatic Dischargers for Aircraft." J. App. Phys. 18, 759-65 (1947).

H-3. Harnwell, G. P.

Principles of Electricity and Electromagnetism. McGraw-Hill Book Co., Inc., 1938.

H-4. Harper, W. R.

22150 ELECTRIFICATION FOLLOWING THE CONTACT OF SOLIDS. W.R.Harper.
Contemporary Physics (GB), Vol. 2, No. 5, 345-59 (June, 1961).

The charge found on solids after they have been rubbed together can only be a direct consequence of friction when the rubbing is vigorous; more usually, the charging is the result of contact, rubbing complicating the phenomenon. Opinions differ regarding the origin of contact charging, but certain experiments suggest a working hypothesis, according to which the charging is due to electron transfer when both materials are either semiconductors or metals, but to ions when insulators take part. Electron transfer is associated with the setting up of a contact potential. Ion transfer can be caused either by a potential difference, in which case the current flows with the e.m.f., or it can be caused by forces that are not electrical in nature, in which case the current flows against the potential difference generated by the "mechanical transfer" of charge.

PA-65-22150

H-5. Harper, W. R.

3057. THE GENERATION OF STATIC CHARGE. W.R.Harper. Advances in Phys., Vol. 6, 365-417 (Oct., 1957).

Experiments and theories on the electrostatic charging produced by (i) the bubbling of a gas through a liquid, and the spraying and shattering of drops, (ii) a liquid when flowing in contact with a solid, (iii) the contact between solids, are dealt with at some length. Reference is also made to the separation of charge which occurs when water freezes and to the generation of charge in a thunderstorm.

PA-61-3057

H-6. Harper, W. R.

"Adhesion and Charging of Quartz Surfaces." Proc. Roy. Soc. A 231, 388-403 (1955).

Very large charges are obtained from the light contact of two crystal faces of quartz with each other, an X cut face being positive with respect to a Z cut. The effect is not piezoelectric in origin, since it does not reverse when an X_- face is used instead of an X_+. The not inconsiderable charges obtained using vitreous silica may be due to patches of incipient crystallization. The tendency of well-cleaned quartz and silica surfaces to adhere seems not to affect the charging, and the adhesion is not electrical in origin. It is unlikely that electrostatic forces ever contribute appreciably to the force of friction. Author

H-7. Harper, W. R.

"The Volta Effect as a cause of Static Electrification." Proc. Roy. Soc. A. 205, 83-103 (1955).

An experimental investigation of the static electrification of metal/metal surfaces shows that the erratic results normally obtained are owing to there being more than one cause, and that the complete elimination of rubbing leaves an effect that is amenable to quantitative measurement. This 'separation charging' is shown to be related to the contact potential, and to have the characteristics to be expected if the Volta-Helmholz hypothesis of its origin is correct. The importance of this explanation of tribo-electrification has long been debated. The supposition that the hypothesis predicts negligible charging of conductor/conductor surfaces is shown to be based on an inadequate understanding of the significance of surface topography at the points of contact. By paying proper attention to this, and revising the hypothesis to allow for the transfer of electrons by tunnel effect, a precise theory of separation charging is derived. When applied to the experiments, agreement within the limits of experimental error is obtained, without the introduction of disposable constants.

Author

H-8. Harper, W. R.

"Surfaces Showing No Electrification After Light Contact with Metals." Proc. Roy. Soc. A. 218, 111-121 (1953).

An experimental investigation of the static electrification of insulating surfaces after light contact with metals shows that hydrophilic surfaces such as glass acquire a considerable charge, whereas hydrophobic surfaces such as amber show negligible charging by comparison. The theoretical significance of this is discussed.

Author

H-9. Harper, W. R.

3420. Liquids giving no electrification by bubbling. W. R. HARPER. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 19–S 22 (1953).

The contention of Gill and Alfrey that electrification by splashing is due to electrostatic induction in the field of a contact potential is discussed in the light of other published work, and it is concluded that this contention cannot be upheld. The orthodox view that electrification of this kind arises from the existence of a double layer in the vicinity of the liquid surface suggests that there should be no charging with a non-conducting liquid, contrary to what has been found by previous workers. Experiments using the method of bubbling are described which show that the electrification does disappear, even with much more sensitive apparatus than previously used, if the purification of a liquid has been carried far enough to reduce its conductivity to below 10^{-13} mho cm^{-1}. The liquids used were hexane, octane, decane, benzene, xylene, pinene, carbon tetrachloride and a mixture of xylene and carbon tetrachloride. The non-conducting liquids still produce considerable quantities of neutral centres.

PA-57-3420

H-10. Harper, W. R.

4363. Interpretation of experiments on frictional electrification. W. R. HARPER. Letter in *Nature Lond.*, 167, 400-1 (*March* 10, 1951).

PA-54-4633

H-11. Heinrich, D. O.

"Process of Electroprecipitation" Elect. Times 127, 967 (1955).

H-12. Hendricks, C. D., Jr.

CHARGED DROPLET EXPERIMENTS.
11346 C.D.Hendricks, Jr.
J. Colloid Sci. (USA), Vol. 17, No. 3, 249-59 (March, 1962).

The velocity and charge of individual charged droplets of oil accelerated through 12 and 13 kV have been measured. From these measurements, the oil density, and the accelerating potential, computations were made of the charge-to-mass ratio, the mass, and the radius of the droplets. The charge-to-mass ratios were 0.91 to 5 coulombs per kilogram and the droplet radii were 0.1 to 10 microns. The charged oil droplets were produced at the point of a hollow stainless steel needle maintained at a high (12-13 kV) positive potential. Rayleigh's theory on the instability of charged liquid drops predicts a maximum limit of charge-to-mass ratio as a function of radius above which the drops become unstable. The maximum observed charge-to-mass ratios of the oil drops at any radius were found to lie very close to the theoretical curve predicted by Rayleigh's theory. This limit was about a factor 50 below the field emission limit predicted on the basis of Muller's work (Abstr. 5158 of 1956) on field emission. PA 65-11346

H-13. Hendricks, C. D., Jr.

"Charged Droplet Experiments," Second Symposium on Adv. Propulsion Concepts, ARDC and AVCO-Everett Res. Lab., Boston, Massachusetts (October 1959).

Experimental techniques for the measurement of charge-to-mass ratios and drop size of electrostatically charged droplets discussed. High potential hollow needles produced electrostatic atomization of octoil. Distribution of radii and charge-mass ratio given, as well as distribution of droplet charge. Size was concentrated in 1 to 4 micron range. Author

H-14. Hendricks, C. D. Jr, et al

"Photomicrography of Electrically Sprayed Heavy Particles." AIAA Electric Prop. Conf., Colorado Springs, Mar. 11-13, 1963. Paper no. 63051-63.

Preliminary analysis of space flight trajectories has shown (1,2,3) that electrostatic thrust devices using particles with charge-to-mass ratios in the range of 10^2 to 10^5 coulomb/kilogram would permit achievement of payload optimization quite readily. In addition, beam neutralization problems would be minimized. The research discussed in this paper is presently aimed at furthering the general knowledge of charged droplet production and behavior by studying the effects of such physical properties as density, viscosity, conductivity, and surface tension, on the charge-to-mass ratio distribution. In this paper, high speed photomicrographs of surface instabilities are presented and discussed and Rayleigh's theory on the instability of charged[4] droplets is extended to include droplet emission.

Author

H-15. Hendricks, C. D., Jr., and J. M. Schneider

14503 STABILITY OF A CONDUCTING DROPLET UNDER THE INFLUENCE OF SURFACE TENSION AND ELECTROSTATIC FORCES. C.D.Hendricks and J.M.Schneider. *Amer. J. Phys.* Vol. 31, No. 6, 450-5 (June, 1963).

The Lagrange equations of motion are written in generalized coordinates which describe small departures from the spherical equilibrium configuration of a conducting liquid droplet. It is initially assumed that the actual shape differs only very slightly from the equilibrium sphere. The equation representing the surface is, then, written as a series of surface zonal harmonics in which the coefficients are shown to be the normal coordinates of the droplet. The frequency of oscillation of the normal coordinates is shown to depend on the total charge on the droplet in such a manner that for all values of charge below a certain limit, the frequency is real. For all values of charge above a certain limit, the frequency is imaginary; and, thus, the droplet is unstable. This paper presents a detailed derivation of a result communicated by Rayleigh in 1882. The results of Rayleigh's communication have been widely quoted but, until now, this particular derivation has not appeared in the literature.

PA-66-14503

H-16. Henriquez, P. C.

A new formula for molecular polarization and molecular refraction. P. Cohen Henriquez. *Rec. trav. chim.* 54, 574-5(1935)

CA-29-6117

H-17. Henry, P. S. H.

3436. Electrostatic eliminators in the textile industry. P. S. H. HENRY. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 78–S 82 (1953).

The occurrence of static electricity in the textile industry, and the ways in which it interferes with production, are briefly described. The general principles of its dissipation are discussed, with special emphasis on the time factor. Brief descriptions are given of the various types of electrostatic eliminator, both electric and radioactive, used in the textile industry, with references to the commercial apparatus.

PA-57-3436

H-18. Henry, P. S. H.

3426. The role of asymmetric rubbing in the generation of static electricity. P. S. H. HENRY. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 31–S 36 (1953).

Two independent types of contact electrification are discussed; the one requiring different surfaces, but not needing friction; the other requiring asymmetric rubbing, but not a difference in the surfaces. It is suggested that the combination of these two effects which occurs when different surfaces are rubbed together (usually asymmetrically) is a contributory factor to the notorious uncertainty of such experiments. It is shown that almost all rubbing processes involve local asymmetry, with the result that like surfaces rubbed together, though each neutral as a whole, are covered with a pattern of opposite charges. A similar effect accounts for the different triboelectric behaviour of surfaces of the same material but different degrees of roughness, and occurs as a complication in the rubbing together of different materials. The part played by asymmetric rubbing between two solids in observed transference of charges to the air is discussed. Experiments are described in which all possible pairs of ten different materials are brought into contact by a method involving the minimum of rubbing. It is shown that the results, with very minor exceptions, are in accordance with the existence of a self-consistent electrostatic series. The separation of charge by the asymmetric rubbing of like surfaces is discussed, and the hypothesis suggested that it is due to the thermal gradient across the interface, and that it is analogous to thermal diffusion and to the Thompson thermoelectric effect in metals. As yet little experimental evidence exists to test this hypothesis, but suggestions are made as to how it might be obtained.

PA-57-3426

H-19. Henry, P. S. H.

3417. Survey of generation and dissipation of static electricity. P. S. H. HENRY. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 6–S 10 (1953).

A general account is given of the principles used in measuring contact electrification, and of the difficulties due to discharges in air and to unknown contact areas. The nature is discussed of the information which might be obtained from work on this subject, and a list is made of the various mechanisms which have been proposed in the past, together with one new hypothesis. The suggestion is made that these are by no means mutually exclusive, and a simple form of theory is worked out to illustrate how several of them might be expected to operate together.

PA-57-3417

H-20. Henry, P. S. H.

1280. Contact electrification. P. S. H. HENRY. *Sci. Progr.*, 41, 617–34 (*Oct.*, 1953).

A review. Points discussed include the polarities and magnitudes of the charges generated and the theories advanced to account for the phenomenon. The effects of "static" in industry and methods of overcoming it are described.

PA-57-1280

H-21. Hermans, J. J.

"Flow Properties of Disperse Systems." Interscience, New York, 1953.

H-22. Hewitt, G. W.

"The Charging of Small Particles for Electrostatic Precipitation." Communication and Electronics No. 31, 300-306, (July 1957).

H-23. Hinkle, B. L. and C. Orr, Jr.

"Electrification in Aerosol Studies." Res. Engineer (Ga. Ins. Tech.) Mar. 1952, pp. 7-8, 19-21.

7829 Electrification in Aerosol Studies. Barton L. Hinkle and Clyde Orr, Jr. *Research Engineer* (Georgia Institute of Technology), Mar. 1952, p. 7-8, 19-21.

Describes experiments to determine the effect of vapors on the aggregation of an aerosol by varying the method of vapor production and by ionizing the air and vapors.

BMI-1-7829

H-24. Hinkle, B. L. et al

6689. **A new method for the measurement of aerosol electrification.** B. L. HINKLE, C. ORR, JR. AND J. M. DALLAVALLE. *J. Colloid Sci.*, **9**, 70–80 (*Feb.*, 1954).

Because of the importance of the electrical forces associated with aerosol particles, an electrification analysis apparatus permitting rapid evaluation of the amounts of negatively and positively charged particles in an aerosol by measurement of the lateral deflection of the aerosol stream in an electrical field has been developed. Results obtained thus far have been in excellent agreement with expectation and with the published data of other investigators. The principal advantages of the method presented are the rapidity and ease of obtaining data and the elimination of the need for numerous samples to give statistically accurate results. An equation is presented for the calculation of the average electron charge carried by particles. PA-57-6089

H-25. Hogan, J. J.

N64-20822 Illinois U., Urbana Charged Particle Research Lab
PARAMETERS INFLUENCING THE CHARGE-TO-MASS RATIO OF ELECTRICALLY SPRAYED LIQUID PARTICLES
James J Hogan 15 Dec 1963 143 p refs
(Grants AF-AFOSR-107-63 NSF G-19776)
(CPRL-2-63)

The problem in this study was to investigate the parameters influencing and the mechanisms involved in the electrical atomization process, i.e., in the process by which liquid surfaces are broken up into small, charged particles as the result of electrostatic forces. Electrical atomization was studied primarily by measuring the charges, masses, velocities, and charge-to-mass ratios (specific charge) of the particles in the beams thus generated. A theoretical study of the electrical dispersion process is presented. The study includes surface energy minimization of the dispersed system of particles, solution of Poisson's equation and the influence of space charge on the specific charge of the emitted particles, and the influence of the conductivity and temperature of the liquid on the generation of charged particles. N64-20822, 14-23

H-26. Hopper, V. D.

5415. The oil-drop method for the determination of the electronic charge. HOPPER, D. V. *Nature, Lond.*, **163**, 733–5 (*May 7*, 1949).—Movements of oil drops in Millikan apparatus were photographed at $\frac{1}{5}$ sec intervals by synchronized sparks. Measurements of the ratio (charge)$^{2/3}$/(viscosity at 23°C), which is independent of the absolute value of viscosity, show that errors can be caused by (i) purity of air, (ii) oxidation of oil drop, (iii) impurities in oil (steel particles). A table giving values of viscosity of air obtained from the results of other workers shows that this is still a major source of error in Millikan's experiment. PA-52-5415

H-27. Hopper, V. D.

5414. The electronic charge and the oil drop method. HOPPER, V. D. *Aust. J. Sci. Res. A*, **1**, 1369–99 (*Dec.*, 1948).—A study has been made of Millikan's oil drop method for determining the electronic charge. Owing to the uncertainty in the value of the viscosity of air, the value of the ratio $e^{2/3}/\eta_{23}$ has been determined and quoted rather than the electronic charge. Some of the factors that have been found to influence this determination are (1) the purity of the air; (2) the influence on the field of the hole in the top plate and the layer of oil which collects in the lower plate of the condenser; (3) corrections to Stokes's equation due to the influence of the walls of the apparatus; (4) oxidation of the oil; and (5) impurities in the oil. From a study of 47 drops of butyl sebacate, and using Stokes's analysis for the resistance to a sphere moving in a viscous medium, the value

$e^{2/3}/\eta_{23} = (335{\cdot}75 \pm 0{\cdot}11) \times 10^{-3}$ (e e.s.u., η_{23} c.g.s.)

has been obtained. This will be increased slightly if Oseen's modification to Stokes's analysis is applied, but the increase will be $< + 0{\cdot}04\%$. PA-52-5414

H-28. Hull, H. H.

"A Method for Studying the Distribution and Sign of Static Charges on Solid Materials." J. App. Phys. 20, 1157-9 (1949).

H-29. Hurd, R. M., G. M. Schmid and E. S. Snavely, Jr.

11347 ELECTROSTATIC FIELDS: THEIR EFFECT ON THE SURFACE TENSION OF AQUEOUS SALT SOLUTIONS.
R.M.Hurd, G.M.Schmid and E.S.Snavely, Jr.
Science (USA), Vol. 135, 791-2 (March 9, 1962).

Electrostatic fields of up to 7000 V cm^{-1} were applied across air/solution interfaces by means of parallel-plate electrodes, and the resulting surface tension changes were obtained by measuring, through a balance linkage, the deflection of mica plates floating on the surface. Surface tension changes (always negative) of up to 0.5 dyn cm^{-1} were observed in both distilled water and dilute sodium chloride solutions. PA-65-11347

H-30. Hutchinson, W. C. A., and J. A. Chalmers

3997. The electric charges and masses of single raindrops. W. C. A. HUTCHINSON AND J. A. CHALMERS. *Quart. J. Roy. Met. Soc.*, 77, 85–95 (*Jan.*, 1951).

Raindrops were admitted by a cone-shaped opening into an insulated vessel connected to a valve amplifier for measuring the drop charge Q. Drop radius a was found by the absorbent paper method. The field at the ground and the point discharge current I were also measured. Most often, but not always, the signs of the drop charge and field were opposite. During point discharge, 173 drop charges and masses were measured, and statistical analysis showed a definite correlation between Q and $-I$, a probable correlation between $QI-I$ and a and a possible correlation between a and $-Q$. By grouping drops according to radius, and taking averages within the groups, the approximate relationship $QI-I \propto a$ was obtained. In one period when the radius was nearly constant, the observations gave the connection $Q \propto -I$ without taking averages. The observed relation between Q and I corresponds to the results of Simpson for the charge on a volume of rain. The observed charges were mostly much higher than predicted on Wilson's ion-capture theory, unless the field increases considerably with height in the atmosphere. PA-54-3997

H-31. Hutchinson, W. M.

"Clean Air for Passenger Cars."
Railway Mech. Engr. 119, No. 2, 79-82 (Feb. 1945).

I-1. Imyanitov, I. M. and A. T. Starovoitov

21688 THEORY OF ELECTROSTATIC CHARGING OF BODIES IN AIR CURRENTS. I.M.Imyanitov and A.T.Starovoitov. Zh. tekh. Fiz. (USSR), Vol. 32, No. 6, 759-65 (June, 1962). In Russian. English translation in: Soviet Physics-Technical Physics (USA), Vol. 7, No. 6, 554-8 (Dec., 1962).

A study is made of the kinetics of electrostatic charging of bodies in air currents, taking into account the conductivity of the medium and the corona discharge current. It is shown that the charging mechanism, in which allowance is made for the contact potential difference between the body and the particles of the air stream, is adequate to explain the high potential found. The values of the potentials calculated from the parameters of the current occurring in the atmosphere are in agreement with those acquired by airplanes in flight.

PA-66-21688

I-2. Ingraham, J. C. and S. F. Philip

13059 EFFECT OF SURFACE CHARGE IN ELECTRIFICATION MEASUREMENTS. J.C.Ingraham and S.F.Philp. Rev. sci. Instrum. (USA), Vol. 32, No. 9, 1032-3 (Sept., 1961).

Although the volume charge distribution in a homogeneous substance decays exponentially with time, in general this will not be true of the electric field above a free surface of the substance, due to the formation of surface charge. This must be taken into account in using the electric field or the surface potential as a measure of the electrification, or the decrease of these quantities as a measure of the time constant of a charged sample. The formation of surface charge during charge relaxation is considered in a simple one-dimensional case. The contribution made by surface charge to the surface potential and electric field above the surface may be large if a grounded object, such as a probe or field meter, is near the surface.

PA-64-13059

I-3. (The)Institute of Physics, London

3413. Static electrification. *Brit. J. appl. Phys. Suppl. No.* 2, 104 *pp.* (1953).

This contains the papers read at a conference held in London in March, 1953. They are arranged under four headings: General principles; Useful applications; Electrostatic machines; Harmful static electrification. For abstracts, see Abstr. 3415-36, 3420-1 (1954).

PA-57-3413

I-4. Irani, R. R., C. F. Callis and T. Liu

"Flow Conditioning and Anti-caking Agents." Ind. Eng. Chem. 51, 1285 (1959).

I-5. Israel, H.

"Messgerate und Arbeits methoden bei Luftelektrischen untersuchungen Ubersicht." Arch. für Tech. Messen. 656, No. 2, 171-174 (1953).

I-6. Israel, H.

3274. Dust Electrification. H. Israel. *Zeits. f. tech. Phys.* 9. 8. *pp.* 289-293, 1928.

The theory of Böning on dust electrification [see Abstract 410 (1928)] is discussed, and experiments with numerous substances are described which extend its scope and show that it is applicable, not only to material of one kind, but to different substances when brought into contact with each other

PA-31-3274

J-1. Jacobi, W.

Electron-microscopic observations in unipolar charged aerosols. Wolfgang Jacobi. *Strahlentherapie* 94, 472-9 (1954).—Unipolar charged aerosols of high dispersity (particle diam. 5-100 mμ) are produced by emission of hot bodies. Size distribution and chem. constitution are analyzed by means of the electron microscope and electron diffraction. Especially the unipolar aerosols used by Dessauer, *et al.* (15 *Jahre Forschung auf dem physikalisch-medizinischen Grenzgebiet*, 1931 (*C.A.* 25, 2747)) are discussed.

Author

J-2. Jaeger, W. and L. F. Weber

Spraying apparatus for the formation of an electrically charged aerosol. Walter Jaeger and Louis F. Weber (to Hydro-Nitro S.A.). Swiss. 270,186, May 1, 1951 (Cl. 9c). A potential difference of at least 100 v. is maintained between a jet of conducting material and a spark electrode situated near the jet. The stable electrically charged aerosol is produced by blowing fluid through the jet in an air stream.

CA-46-1896c

J-3. Jakubiszyn, S. et al

14645 **ELECTRIFICATION OF THE DUST OF NaCl AND KCl WHISKERS.**

S.Jakubiszyn, J.Niklibore, H.Wolniewicz and A.Szaynok.
J. appl. Phys. (USA), Vol. 33, No. 7, 2224-6 (July, 1962).

The dust of NaCl and KCl ordinary monocrystals shows greater charge per particle surface area than the dust of whiskers of these materials. The main reason is a greater cleavage surface of monocrystals than the cleavage surface of whiskers. The electrification of the dust is also influenced by the presence of contaminations in the crystal. PA-65-14645

J-4. Jamba, D. M. and B. Hornstein

"Charging and Removal of Surface-Condensed Particles for Colloid Propulsion."
AIAA Electric. Prop. Conf., Colorado Springs, Mar. 11-13, 1963 Paper No. 63053-63.

Since the report on a "Heavy Particle Source" was given last year, the work at this laboratory has been concentrated on the charging and removal of particles so formed, (i.e. by condensing metal vapors on surfaces in vacuum). The necessary apparatus has been designed and constructed for charging, accelerating and measuring the electrical properties of charged particles having any charge to mass ratio. The apparatus is based on the measurement of the time of flight of charged particles, where the flight is initiated by the application of a high voltage pulse and completed at a charge detecting device. Maximum detector sensitivity has been obtained with an electron multiplier structure as the target.

Author

J-5. Johnson, C.

23857 PRODUCTION OF LIQUID DROPS.
C.Johnson.
Nature (GB), Vol. 197, 1092-3 (March 16, 1963).

A photographic study of drop formation from a hypodermic steel needle when the needle is at a smooth potential of 4 kV. The application of this potential decreased the size of drops to such an extent that to the naked eye they appeared as a continuous jet, the frequency of drops being increased from 3-4/sec to 300/sec. Qualitative explanation of photographs suggests that electrostatic forces opposing surface tension at surfaces of high radius of curvature weakens the area, causing increased flow, thus creating a sharp nosed filament, necking and subsequent small drop formation.

PA-66-23857

J-6. Johnson, V. A.

"Electrets, Part I. A State-of-the-Art Survey." Army Material Command, Harry Diamond Laboratories, Wash., D. C., Ord. Corps HDL-7R-1045, Aug. 31, 1962 (AD 299, 259). CRDL No. 74, 721

J-7. Johnstone, H. F.

Fundamental properties of aerosols. H. F. Johnstone (Univ. of Illinois, Urbana). *U.S. Atomic Energy Comm.* TID-7551, 108(1957).

CA-52-15282d

J-8. Jones, J. H.

"The Electrostatic Charging of Coal." Colliery Eng. 26, 112-3, 137 (April 1949).

J-9. Jones, J. H.

574. *Influence of Surrounding Medium on Frictional Electricity.* J. H. Jones. (Phil. Mag. 50. pp. 1160–1177, Nov., 1925.)—The rubber was mounted on a disc carried by the shaft of a motor and the specimen held in contact. Both disc and specimen were enclosed in an air-tight vessel so that the effect of various gases and liquids could be observed. A modified quadrant electrometer with slate needle was used to measure the potential. Better results were obtained with a conducting disc than with an insulator. If a metal is rubbed against slate in air and the potential is low, the introduction of coal-gas, H_2, or CO_2 causes it to rise, and *vice versa*. The introduction of SO_2 causes the potential to rise, whether it was high or low in air. The potential of the metal is increased by the presence of a liquid of appreciable conductivity. The effect of a liquid insulator increases with rise of temperature up to a certain point, when the insulation appears to break down. The temperature of the rubbed metal rises almost in proportion to its potential. PA-29-574

J-10. Jones, W. H.

1319. Frictional Electricity. W. H. Jones. *Phys. Soc., Reports, 4. pp. 247–250, 1938.*—Progress review.

PA-41-1319

J-11. Jordan, D. W.

1283. The adhesion of dust particles. D. W. JORDAN. *Brit. J. appl. Phys., Suppl. No. 3 [Physics of particle size analysis]* S 194–S 198 (1954).

An important factor in the handling of dust is the fact that the particles will adhere to each other and to solid surfaces. The mechanism by which this takes place is discussed and some quantitative results are given. It is shown that the intermolecular force between the surfaces in contact is large enough to account for this phenomenon of adhesion, although in some cases electrical forces and other processes may operate giving considerably greater attraction. An application to dust sampling problems is also mentioned. PA-58-1283

J-12. Junge, Ch.

"The Size Distribution and Aging of Natural Aerosols as Determined from Electrical and Optical Data on the Atmosphere." J. Meteorology 12, No. 1, 13 (1955).

A first attempt at surveying the complete size distribution of natural aerosol particles is made. The size range covers more than three orders of magnitude in radius, with approximate limits of 2×10^{-4} and 5×10^{-2} cm. Previously only parts of this spectrum had been carefully investigated, due to the size limits of the various experimental methods used. Particle spectra down to radii below 10^{-4} cm are well known, having been obtained by direct count under the microscope. Particles of radius less than 10^{-5} cm are counted in the Aitken counter, but their size distribution can only be determined from mobility measurements on those particles which are charged. However, to deduce nuclei spectra from ion spectra, the fraction of charged particles must be known. Previous determinations of this fraction are examined and are shown to contain inaccuracies or errors. The expression derived here theoretically, is used to convert some of the ion-spectra data into nuclei spectra. The particle-size range between radii of 10^{-6} and 10^{-4} cm has hardly been investigated by direct measurements, because of the experimental difficulties encountered. Valuable information can be gained here from the dependence of haze scattering on wavelength.

The available data seem to indicate that the maximum number concentration is located in the size region between 10^{-7} and 10^{-6} cm radius, and that the number concentration drops to zero between 10^{-6} cm and 10 cm radius. The size range greater than 10^{-6} cm can be well represented by a power law which seems to hold for large parts of the world. It can be shown further, where ion and nuclei counts or other electrical data are available from a large number of places all over the world, that the average radius of all particles increases when the total number decreases. This can be explained by coagulation processes.

It should be emphasized that the results obtained in this article are to be considered as a rough first approach, valid only for average conditions in time and space, and that more detailed information is needed to improve our knowledge of this field.

Author

J-13. Jutzi, Werner

15530* (Electrical Properties of Coarse-Colloidal Aerosols.) **Beitrag zur Kenntnis der elektrischen Eigenschaften grobkolloider Aerosole.** Werner Jutzi. *Staub*, 1954, no. 36, p. 165-212.

Reasons for electric charge; determining magnitude and sign. Quartz-, hexadecane-, titanium dioxide-, and ammonium chloride-air systems. Tables, graphs, diagrams, photographic micrographs. 63 ref. BMI 3-15530

K-1. Kachurin, L. G. and V. I. Bekryaev

10658 AN INVESTIGATION OF THE PROCESS OF ELECTRIFICATION OF CRYSTALLIZING WATER.
L.G.Kachurin and V.I.Bekryaev.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 1, 57-60 (Jan. 1, 1960).
In Russian.

The charge division that occurs near the boundaries of a phase transformation in a substance is an important factor in problems of atmospheric electricity such as lightning protection of transmission lines, radio noise elimination etc. Experiments are described in which a drop of water is held on a wire loop and lowered into a central shaft in a thermostat whilst remaining at the focus of a microscope, the microscope being connected with a cine camera. The other end of the wire is joined either to an electrometer or, via an amplifier, to an oscilloscope. Photographs show the stages of crystallization and bursting of a drop. Some drops burst on crystallization and produce a significant charge, others do not. A table gives the charge of 70 bursting drops of 0.2 to 2 mm diameter at -3 to -20°. The results are of the same order as obtained for thunder clouds.

PA-63-10858

K-2. Kay, K.

A study of some factors in the behavior of air-borne agglomerates. Kingsley Kay (Dept. Natl. Health Welfare, Ottawa, Can.), and H. F. Johnstone. *Am. Chem. Soc., Div. Water Waste Chem., Preprints* 1962(Sept.), 29-30.

CA-61-1166e

K-3. Keefe, D. and P. J. Nolan

22164 COMBINATION COEFFICIENTS OF IONS AND NUCLEI.
D.Keefe and P.J.Nolan.
Proc. Roy. Irish Acad. A, Vol. 62, No. 4, 43-53 (May, 1962).

Values of the ion—nucleus combination coefficient η_0 are calculated for various values of the nuclear radius and are compared with experiment. It is shown that the use of the coefficient b in the equation $q = bnZ$ when equilibrium is absent, does not entail serious error. Values of the coefficient b are deduced by obtaining the ratio b/η_0 from the application of the Boltzmann law. The combination coefficients of charged and uncharged nuclei in the size range, radius $> 3 \times 10^{-8}$ cm, are obtained in two ways with satisfactory agreement.

PA 65-22164

K-4. Keefe, D. et al

7073 CHARGE EQUILIBRIUM IN AEROSOLS ACCORDING TO THE BOLTZMANN LAW.
D.Keefe, P.J.Nolan and T.A.Rich.
Proc. Roy. Irish Acad. A, Vol. 60, No. 4, 27-45 (July, 1959).

The consequences are examined of treating charged aerosol particles as having an excess energy due to their charge and applying the Boltzmann distribution law to their equilibrium with small ions. The results are found to be in agreement with the available experimental determinations in the range $4 \times 10^{-8} < r < 14 \times 10^{-8}$ cm. For radii greater than 2×10^{-8} cm a simple formula is established: $Z/N_0 = K\sqrt{r}$, where $K = \sqrt{(2\pi\kappa T/\epsilon^2)}$. For large particles, it is found that the average number of elementary charges per particle is $= \pi^{-1}(Z/N_0)$ and that the average charge per particle is $\sqrt{(2r\kappa T/\pi)}$. It is shown that the average electrical energy per particle is $\frac{1}{2}\kappa T$ and thus that equipartition exists between the electrical and mechanical degrees of freedom. Simple formulae are deduced for the ratios of the various combination coefficients of particles and ions. These are found to agree for large particles with formulae for combination coefficients established by Harper, Pluvinage, Bricard and Gunn. For large particles a difference formula of the Whipple type is found to hold approximately, but the difference is one-half that proposed by Whipple for smaller particles. A new way of arriving at combination coefficient ratios by a consideration of the distortion of ionic trajectories is described and found to give satisfactory results for large particles when the effect of image charges is taken into account. For particles and condensation nuclei less than about 10^{-8} cm in radius, difficulties arise in applying the equation for coefficient ratios. The implications of the apparent inapplicability of the Boltzmann Law to very small particles are discussed.

PA-63-7073

K-5. Kitaev, A. V.

Relations pertaining to the application of ionized air and of unipolar aerosols. A. V. Kitaev (Sci. Res. Inst. Med. Instruments and Equipment, Moscow). *Zh. Fiz. Khim.* 36, 1136-9(1962).

A method has been proposed for the calculation of the vibrational partition function, based on the use of special functions set up in a similar way to the usual exponential functions.

Assuming a finite limit to the sets of vibrational and rotational quantum numbers the proposed method has been used to calculate the partition function of a non-linear polyatomic molecule without degenerate vibrations and internal rotations.

Author

K-6. Kitaev, A. V.

KITAEV, A. V.
R-4212. Unipolar electrification of aerosols in the field of the corona discharge. Vestnik Sel'skokhoz. Nauk., 2, no.9, p.127-131, September, 1957. (12p.)

TM 4-252

K-7. Kitaev, A. V. and L. N. Kloiz

Ion and electroaerosol spectrometer. A. V. Kitaev and L. N. Kloiz. *Tr. Vses. Nauchn.-Issled. Inst. Med. Instrumentov i Oborud.*, 1963(1), 131-4.

CA 61-1365h

K-8. Kittaka, S.

12199. THE GENERATION OF STATIC CHARGE ON HIGH POLYMER. S.Kittaka.
J. Phys. Soc. Japan, Vol. 14, No. 4, 533-8 (April, 1959).

The generation of static electricity by the contact and separation between high polymer substances and metals was studied. The combinations: polystyrene—Pt, Acrylite (polymethylmethacrylate)—Pt, and Teflon (polytetrafluorethylene)—Pt were examined. It was observed that the surrounding conditions have serious effects on the quantity and sign of the static charge generated. A mechanism of generation of the electrostatic charge has been proposed assuming the energy levels of the localized electrons on the surface of high polymer substances and the change of these energy levels by the absorption of different gases. It was estimated that work functions of polystyrene, Acrylite, and Teflon are 5.74, 5.48 and 5.04 eV, respectively.

PA-63-12199

K-9. Klinkenberg, A.

Induction of electrical charge with poorly conducting liquids in turbulent flow. A. Klinkenberg (Roy. Dutch/Shell-Gruppe, Hague, Neth.). *Chem.-Ingr.-Tech.* 36(3), 283-90(1964).

CA 61-319e

K-10. Klinkenberg, A. and J. L. von der Minne

(Review from Brit. J. App. Phys. 9, 230 (1958).

Electrostatics in the petroleum industry. Edited by A. KLINKENBERG and J. L. VAN DER MINNE. (Amsterdam: Elsevier Publishing Co.; London: Cleaver-Hume Press Ltd., 1958.) Pp. 191. Price 40s.

This, so far as the reviewer is aware, is one of the first full-length books on the subject of "static" that has appeared in the English language. It deals, however, exclusively with one branch of the subject—that concerned with the separation of charge when a liquid of low electrical conductivity is disturbed in contact with other matter, and its relation to safety in the oil industry. This it does extremely well, with a precision and clarity that contrast strongly with that of most literature on "static" to be found in industrial journals. Indeed, the reviewer finds this book hard to fault.

After an introductory section of four chapters which, in effect, summarize the whole book (a novel scheme, but admirable where appropriate), and a further chapter expounding some of the elementary physics to be employed, the mechanism of charge separation at the interface between oils and other substances is discussed, followed by a consideration of the relevant properties of oils and how they are measured. Finally the results of large-scale tests are described with special reference to the effects of ionic impurities—natural or otherwise. These, we learn, are at once the nigger in the wood pile and the saving grace—nigger if present in minute amounts, grace if slightly more plentiful.

The editors are evidently enthusiasts for the MKS system of units; chemical readers may be a little surprised to find concentrations of solutions expressed in "kilomoles per cubic metre," but will no doubt be relieved after a moment's thought to realize that, apart from a negligible correction, these are numerically equal to their old friends "moles per litre."

There is no evidence in the book of any commercial secrecy on matters concerned with safety: the composition and concentration of the anti-static additives found most effective are given (but covered by patent). The presentation is excellent, in view of which the price can be considered moderate.

K-11. Kluge, W.

1618. Excitation of Frictional Electricity between Metals and Non-Conductors in Relation to the Pressure of the Surrounding Gas and the Condition of the Metal. W. Kluge. *Ann. d. Physik*, 1. 1. *pp.* 1–39, *Jan.* 2, 1929.

An apparatus is described by means of which the electrical properties of platinum, gold and palladium foil were measured in a high vacuum. Silk, used in rubbing the metals, was attached to a rotating wheel, and measurements were made of the pressure applied in rubbing, the work expended in friction, the resulting voltage of the foil, and the electrical state of the silk. In a high vacuum the polarity obtained is always reproducible, and the normal polarity of these metals is negative in the conditions mentioned. The amount of the charge due to a given rubbing depends on the surface condition of the metal; it is very small at atmospheric pressure, increases in a vacuum, and is further increased after the metal has been heated to redness. When air is again allowed to surround the metal, the latter returns to its previous condition. A temporary positive polarity of the platinum is ascribed to the presence of Pt dust.

PA-32-1618

K-12. Knappwost, A.

Collective paramagnetism and volume of magnetized aerosols. A. Knappwost (Univ. Tübingen, Ger.). *Z. Elektrochem.* 61, 1328-34(1957):

Das Verfahren der magnetischen Teilchengrößenbestimmung mit Hilfe der Langevinschen Theorie für kollektivparamagnetische Partikel wird auf die früher von Haul und Schoon hergestellten γ-Fe_2O_3-Aerosole angewandt, deren Ausdehnung von den Autoren elektronographisch zu 30–40 Å gefunden wurde. Nach Ermittlung der spontanen Magnetisierung des γ-Fe_2O_3 mittels einer Variante der Felddifferenzmethode und nach Anwendung eines Iterationsverfahrens zur Berücksichtigung der Teilchengrößenabhängigkeit der spontanen Magnetisierung wird die Ausdehnung der Bereiche zu 27 Å gefunden und gezeigt, daß die magnetochemische Methode richtige Werte liefert und zu weiteren Aussagen fähig ist. Die Feldstärkeabhängigkeit der Suszeptibilität der Aerosole, deren Ursache im einzelnen diskutiert wird, die aber nach Berechnung des Argumentbetrages der Langevin-Funktion aus dem Volumen der Bereiche bei den niederen Meßfeldstärken von etwa 5000 Oe nicht auftreten dürfte, weist auf eine erhebliche Breite der Größenverteilungskurve der Aerosole hin. Es wird ferner dargelegt, daß die Feldstärkeabhängigkeit der Suszeptibilität kein Kriterium für das Einsetzen der spontanen Magnetisierung ist, die schon in kleineren Teilchen als solchen von 20 Å Ausdehnung vorliegen dürfte.

Author

K-13. Knoblauch, O.

"Versuche über die Beröhrungselektrizität"
("Experiments on Contact Electricity")
Z. Physik Chem. 39, 225-44, (1902).

K-14. Kolbe, F.

"Dry Lurgi Dust Precipitator for L. D. Process"
Berg-und Hüttenmännische Monatshefte 104, No. 2,
26-31 (1959).

K-15. Kolin, A.

J633 An Electromagnetokinetic Phenomenon Involving Migration of Neutral Particles. Alexander Kolin. *Science*, v. 117, Feb. 6, 1953, p. 134-137.
Shows that electrical conductivity of irregular bodies and microscopic particles may be measured by finding conductivity of a solution in which they experience no electromagnetic force. Diagrams.
BMI-2-3633

K-16. Koller, L. R. and H. A. Fremont

"Negative Wire Corona at High Temperature and Pressure."

J. App. Phys. 21, No. 8, 741-744 (Aug. 1950).

K-17. Koncar-Djurdjeric, S; L. Capo; D. Vukovic

"Influence of Certain Factors of Fluidization on the Electrification of Particles."
Genie Chemique, Supp. 4, 86, 110-115 (1961).

Le phénomène d'électrisation des corpuscules pendant la fluidisation par le gaz est étudié en mesurant la différence de potentiel entre l'électrode métallique immergée dans le lit fluidisé et la grille au fond de la colonne.
On étudie l'effet du débit de l'air, des constantes diélectriques et de la composition du mélange des corpuscules. Malgré la grande complexité apparente du phénomène, on a trouvé des relations simples entre les facteurs en jeu.
On a observé une différence entre la composition des mélanges fluidisés et la matière déposée sur l'électrode. Il en découle une possibilité de réalisation d'une méthode technique nouvelle de séparation des matières en faisant intervenir les caractéristiques physiques des matières fluidisées, ainsi que celles des fluides servant à la fluidisation.
Author

K-18. Konorski, B.

601. CERTAIN PROPERTIES OF THE ELECTROSTATIC FIELD OF TWO SPHERES. B.Konorski.
Arch. Elektrotech. (Berlin), Vol. 43, No. 4, 225-49 (1957).
In German.
A detailed mathematical analysis of the classical problem of the spatial field determined by two charged spheres at a finite distance apart. The method of images is worked out fully and values for the field strength and induced charge are tabulated for a range of values of all the relevant parameters.
PA-61-601

K-19. Konorski, B.

1244. LIMIT ANGLES IN THE ELECTROSTATIC FIELD OF TWO SPHERES BEARING CHARGES OF OPPOSITE POLARITY.
B.Konorski.
Arch. elektrotech. (Warsaw), Vol. 5, No. 2, 211-49 (1956). In Polish.
On the sphere bearing larger charge a circle determines the limit between field lines ending at the other sphere and those going to infinity. The solid angle corresponding to the circle is calculated first for a simple case of a point and a sphere, then equations for the general case are established and applied to numerical examples.
PA-60-1244

K-20. Koszman, I and J. Gavis

"Development of Change in Low-conductivity Liquids Flowing Past Surfaces."
Chem. Engr. Sci. 17, 1023-1040 (1962).

Abstract—A theory, developed earlier by the authors, which describes charge generation in the turbulent flow of low-conductivity (hydrocarbon) liquids in tubes, is recapitulated. The theory is extended, by use of well known correlations of turbulent mass transfer, into a form which may be easily tested experimentally, and from which engineering predictions may be made. The charging current is shown to be a universal function of a dimensionless group—four times the square of the tube radius divided by the product of the kinematic viscosity of the hydrocarbon, its relaxation time and the seven-fourths power of the Reynolds number—which turns out to be related to the ratio of the laminar subzone thickness to the diffuse double-layer thickness in the liquid. For small enough values of this group the current can be predicted by the theory; for larger values of the group the theory is unable to predict the current. The highest value of the dimensionless group where the theory can predict the current must be obtained experimentally.
Author

K-21. Kraemer, H. F.

See Also, Univ. of Illinois, Kraemer, H. F., AT (11-1-276 (AEC).

Properties of electrically charged aerosols. Herbert F. Kraemer (Univ. of Illinois, Urbana). *Univ. Microfilms* (Ann Arbor, Mich.), *Publ.* No. 9098, 140 pp. (microfilm, $1.75; paper enlargement, $14.00); *Dissertation Abstr.* 14, 1655(1954).
CA-49-3443f

K-22. Kraemer, H. F. and H. F. Johnstone

"Collection of Aerosol Particles in Presence of Electro-Static Fields."
Ind. and Eng. Chem. 47, 12, 2426-34 (Dec. 1955).

K-23. Krajewski, J. and S. Herszderfer

Krajewski, Jan and Herszderfer, Szymon.
THE ELECTROSTATIC ENRICHMENT OF COALS, PT. II (Wzbogacanie Elektrostatyczne Wegli, cz. II) tr. by Ignacy Dmowski. 1961 [33]p. 14 refs. [PL-480].
Order from OTS $0.50 60-21290

Trans. of Glowny Instytut Gornictwa. [Komunikat] (Poland) 1952, no. 121, p. 3-21.

DESCRIPTORS: *Coal, Poland, Particles, Separation, Electric potential, *Electrostatic fields, Intensity.

To test the suitability of the electrostatic method for the enrichment of coals from Upper and Lower Silesia, investigations of the conditions of enrichment were made with an electrostatic separator of the author's design. The investigations were aimed at determining the influence on processing of field intensity, humidity and grain sizes. Coals from fourteen collieries were tested. Graphs were drawn of enrichment as a function of electric potential. Comparison was made between the curves of electrostatic enrichment and of enrichment in heavy liquids. A diagram was constructed of coal yields as a function of the coalification of the raw coals. The relationship was determined between the results of enrichment and the degree of coalification of the raw coal, of coal humidity, of grain sizes and of the intensity of the electrostatic fields. T6-664

K-24. Krajewski, J. and S. Herszderfer

Krajewski, Jan and Herszderfer, Szymon.
ELECTROSTATIC SEPARATION OF COALS (Wzbogacanie Elektrostatyczne Wegli) tr. by Jerzy Osuchowski. 1960 [7]p. 2 refs. [PL-480].
Order from OTS $0.50 60-21288

Trans. of Glowny Instytut Gornictwa. [Komunikat] (Poland) 1951, no. 78, p. 1-4.

DESCRIPTORS: *Coal, Poland, Particles, Separation *Electrostatics, Minerals, Electrical properties. Conductivity, Hydrogen

Tests on electrical conductivity of petrographic types of coals and associated mineral matter were made with a view to obtaining some data for electrostatic separation of coal dusts. The tests were carried out on polished prisms of individual petrographic types of coals and mineral matter as well as on granules of the same samples of bright coals. Differences have been found in electrical conductivity of individual petrographic types of coals and of contaminating mineral constituents, the differences being particularly great for fusain, as compared with vitrain, clarain and durain. Considerable differences were also found in electrical conductivity of coals with low and high hydrogen content. T6-664

K-25. Kunkel, W. B.

Comment on static electrification of dust particles on dispersion into a cloud. W. B. KUNKEL. Letters in *J. Appl. Phys.*, 22, 103-4 (*Jan.*, 1951).

See Abstr. 7223 (*1950*). *Attention is drawn to* earlier work [Whitman, *Phys. Rev.*, 28, 1287 (1926)] *which is in agreement. Kunkel gives added explanation.* PA-54-2656

K-26. Kunkel, W. B.

7224. Charge distribution in coarse aerosols as a function of time. W. B. KUNKEL. *J. Appl. Phys.*, 21, 833-7 (*Aug.*, 1950).

The interaction of small particles suspended in air with the ions normally produced in the air is discussed. The neutralization of highly charged dust particles, if suspended in air, is treated in detail. The result is found to be in qualitative agreement with experiment. The special case of final equilibrium is investigated. It is found that multiply-charged particles should be present in appreciable number in coarse aerosols at all times. This is confirmed by experiments both for initially charged quartz dust and for initially neutral ammonium chloride smoke. The general nature of an equilibrium charge distribution is presented. Charges up to ten electron units are found to be not uncommon. PA-53-7224

K-27. Kunkel, W. B.

7223. The static electrification of dust particles on dispersion into a cloud. W. B. KUNKEL. *J. Appl Phys.*, 21, 820-32 (*Aug.*, 1950).

An extensive study of the charge and size distribution of particles from 0·5 to 30 microns radius in dust clouds of various types dispersed in air under a variety of conditions ranging from blowing with minimum of turbulence to conditions of violent and maximum impact with various types of surfaces was made using adaptations of the Hopper and Laby modification of the oil drop experiment. It was observed that all dusts, including homogeneous dusts with no impacts on solid surfaces, were charged. In homogeneous systems the charges of opposite sign were equal, no net charge resulting, the number of particles of similar size with opposite charges being about the same. The magnitude of charges increased somewhat less rapidly than the surface of the particle. There was no correlation between size and sign of charge. There is strong evidence that charging occurs on separation of the contacts between particles in the dispersion of the cloud. Humidity did not affect the charging. Studies of heterogeneous systems making contact with solid walls of different composition from the powder gave consistent asymmetry of charge of varying degrees depending on the proportion of particles striking the surfaces relative to those just separated. PA-53-7223

K-28. Kunkel, W. B.

1021. Growth of charged particles in clouds. KUNKEL, W. *J. Appl. Phys.*, 19, 1053–5 (*Nov.*, 1948). - In order to calculate the average growth of a charged particle in a dust cloud caused by electrostatic attraction, the following assumptions were made: the particles obey Stokes' law of motion, their velocities are small so that their motion can be considered to be in constant equilibrium with the forces acting, and the forces are effective at short ranges only or the cloud density is small enough so that not more than two particles have to be considered interacting at a time. In addition to the Coulomb force, there will appear an attraction between particles resulting from induced dipoles, but it was found that in general the effect of this force can be neglected. Straightforward integration of the equation of relative motion of two charged dust particles yields their effective cross-section for aggregation from which in turn can be determined the rate of growth if the particle size and charge distribution in the cloud are known. Assuming a highly simplified distribution, one arrives at the result that aggregation is negligible if the cloud density is $<10^6$ particles/cm^3 or if the average charge of one sign is <1 000 electrons per particle. PA-52-1021

K-29. Kunkel, W. B. and J. W. Hansen

6488. A dust electricity analyzer. W. B. KUNKEL AND J. W. HANSEN. *Rev. Sc. Instrum.*, 21, 308–14 (*April*, 1950).

An apparatus is described by means of which the size and the charge of large numbers of microscopic particles can be simultaneously determined. The method is based on Hopper and Laby's work on the determination of the electronic charge, i.e. horizontal deflection of particles settling under gravity recorded photographically. The procedures involved are given in some detail, and the nature and limitations of the general results are discussed. Simplicity of operation and design are emphasized to render the instrument a workable tool in industrial research. PA-53-6488

K-30. Kuz'min, D. V.

1253. DIPOLE MOMENTS OF DIELECTRIC AND SEMICONDUCTING PARTICLES. D.V.Kuz'min.
Zh. tekh. Fiz., Vol. 26, No. 9, 1880-3 (1956). In Russian.

Expressions are derived for the dipole moment of a sphere suspended in an electric field between parallel plates in terms of dielectric constants and resistivities. Direct and alternating fields are considered. The phase difference between the alternating field and the dipole moment is calculated. PA-60-1253

L-1. **Ladenberg, R.**

"Investigation of the Physical Process of the Electric Gas Purifier. Part II - The Effect of the Electric Wind." Ann. Physik (5) 6, 581-621 (1930).

L-2. **Ladenberg, R.**

"Investigations into Physical Processes for Electrical Gas Purification." Ann. Physik (5) 4 863-97 (1930).

L-3. **Lagarias, J. S.**

"Discharge Electrodes and Electrostatic Precipitators." Air Pollution Control Association No. 59-51 (1959).

L-4. **Lakey, J. R. A. and W. Bostock**

10240 Researches Into Factors Affecting Electro-Precipitation. J. R. A. Lakey and W. Bostock. *Institution of Chemical Engineers, Transactions*, v. 33, no. 4, 1955, p. 252-263.

Corona discharge; resistivity; effects of dust accumulations on electrodes, methods of measuring electrical resistivity. Photograph, tables, graphs, diagrams. 13 ref.

BMI 5-10246

L-5. **Lam, S. H.**

4529 A General Theory for the Flow of **Weakly Ionized Gases.**– A general theory is developed for the flow of a weakly ionized gas about an arbitrary solid body with absorbing surfaces. The main interest lies in the prediction of the electrical properties of the body as a function of the pertinent properties of the gas. The theory is based on continuum formulation. Charge-gas analytical results are obtained for the floating potential and the **current-voltage characteristic.** – S. H. Lam. *AIAA journal*, v. 2, Feb. 1964, p. 256-262.

BMI 13-4529

L-6. Landolt, P. E.

"Separation - Solids from Gases." Chem. and Met. Engr. 29, No. 13, 588-589 (Sept. 24, 1923).

L-7. Landolt, P. E.

"Eliminating Waste and Nuisance in Smoke, Fume and Gas. Chem. and Met. Eng. 25, No. 9, 428-432 (Aug. 31, 1921).

L-8. Langer, G. and J. L. Radnik

"Development and Preliminary Testing of a Device for Electrostatic Classification of Submicron Airborne Particles." J. Appl. Phys. 32, No. 5, 955-957 (1961).

L-9. Large, M. I. and E. T. Pierce

"The Fine Structure of Natural Point-Discharge Currents." Quarterly J. Roy. Met. Soc. 81, No. 347, 92-95 (Jan. 1955).

Since Franklin's experiment meteorologists have known that in disturbed weather the electrostatic field near the earth's surface can be intense enough for point-discharge currents to flow from raised points. C. T. R. Wilson (1925) was the first to suggest that these point-discharge currents might be extremely important in the exchange of electricity between the earth and the upper atmosphere, and this suggestion has been investigated and confirmed by subsequent workers in atmospheric electricity. Point-discharge is also a familiar phenomenon to electrical engineers, who usually call it corona discharge. Loeb and his colleagues in particular have done a great deal of work on discharge in a point-to-plane gap for air at atmospheric pressure. While meteorologists have been mainly concerned with the magnitudes of point-discharge currents, electrical engineers have investigated in some detail the mechanism of the discharge and they have shown that the current is often made up of a series of pulses.

It is the purpose of this paper to show that many of the effects observed in laboratory experiments on corona discharge are apparent in natural point-discharge in disturbed weather, and that much of the information gained by electrical engineers may be applied directly by meteorologists to natural point-discharge.

Author

L-10. **Latham, J.**

19158 **ELECTRIFICATION PRODUCED BY THE ASYMMETRIC RUBBING OF ICE ON ICE.** J.Latham.
Brit. J. appl. Phys., Vol. 14, No. 8, 488-90 (Aug., 1963).

Experiments showed that when an ice specimen was allowed to slide over an ice surface the specimen became hotter than the surface and aquired negative charge: the charge separation was proportional to the temperature difference created. The magnitude of the electrification is explicable in terms of the Latham–Mason theory of charge transfer associated with temperature gradients in ice.

PA 66-19158

L-11. **Latham, J. and B. J. Mason**

20835 **GENERATION OF ELECTRIC CHARGE ASSOCIATED WITH THE FORMATION OF SOFT HAIL IN THUNDERCLOUDS.** J.Latham and B.J.Mason.
Proc. Roy. Soc. A (GB), Vol. 260, 537-49 (March 21, 1961).

The electrical charging which results from collisions between ice crystals and a simulated hailstone is measured as a function of their temperature difference, and of the size and impact velocity of the crystals. It is found that the sign of the charging is governed by that of the temperature difference, the hailstone becoming negatively charged if it is warmer than the rebounding crystals. The magnitude of the charging is proportional to the temperature difference but rather insensitive to the size and impact velocity of the crystals. With a temperature difference of 5 deg C, a rebounding crystal of diameter about 50μ produces, on average, a charge of 5×10^{-5} e.s.u. The electrification of an artificial pellet of soft hail growing by the accretion of supercooled water droplets (riming) is also investigated. Freezing of the droplets on the hailstone is accompanied by the ejection of positively charged ice splinters, the hailstone acquiring a negative charge. The manner in which the rates of charging and splinter production vary with the air temperature, drop diameter and impact velocity has been established. In a typical experiment, with the air temperature at -15°C, droplets of diameter 80μ impacting at 10 msec^{-1} freeze to produce, on average, 12 splinters and a charge of 4×10^{-6} e.s.u. per drop. Droplets of diameter less than 30μ produce few splinters and little charging. The results of both sets of experiments are interpreted in terms of the author's theory of charge separation in ice under the influence of a temperature gradient, and are used to calculate probable rates of charge generation in thunderstorms. It appears that the electrification which accompanies the growth of pellets of soft hail through the freezing and splintering of supercooled droplets is capable of generating and separating charge at the required rate of about 1 C km^{-3} min^{-1} but, while rebounding ice crystals will usually charge the hailstones in the same (negative) sense, this mechanism will contribute only slightly to thunderstorm electrification.

PA-64-20835

L-12. **Latham, J. and B. J. Mason**

20834 **ELECTRIC CHARGE TRANSFER ASSOCIATED WITH TEMPERATURE GRADIENTS IN ICE.**
J.Latham and B.J.Mason.
Proc. Roy. Soc. A (GB), Vol. 260, 523-36 (March 21, 1961).

The development of electric potentials in ice crystals under the influence of temperature gradients is investigated both theoretically and experimentally. The maintenance of a steady temperature gradient across a piece of ice is accompanied by concentration gradients of H^+ and OH^- ions; because of the much greater mobility of H^+ ions, these diffuse more rapidly into the colder part of the ice and, in the steady state, a potential difference is set up across the ice crystal, the colder end being positive. A theory of this effect predicts a surface density of charge on the ends of the ice of $\sigma = 5 \times 10^{-5}(dT/dx)$ e.s.u. cm^{-2} and a potential difference across a uniform specimen of about $2\Delta T$ mV, where ΔT is the temperature difference across the ends. These values are quite well confirmed by a series of experiments on specimens of highly purified ice. When two pieces of ice of initially different temperatures are brought into temporary contact and separated, the warmer acquires a negative charge and the colder an equal positive charge. The theory indicates that a maximum charge transfer of $3 \times 10^{-5}\ \Delta T$, e.s.u. cm^{-2} should occur with a contact time of about 0.01 s and that it should thereafter decline as the two pieces of ice become more nearly equal in temperature. The theoretical value for the charge developed for a contact time of ~0.01 s is well confirmed by experiments which also show that very little charge separation occurs if the contact period exceeds $\frac{1}{2}$ s. Experiments in which the ice was contaminated with carbon dioxide, hydrofluoric acid, and sodium chloride in concentrations of up to 50 times that normally present in rain water, showed that the electrification was not greatly influenced by these impurities. These phenomena are thought to be of basic importance in the generation of electric charge in thunderstorms. This aspect is developed in the following paper.

PA-64-26834

L-13. **Lebedev, N. N. and I. P. Skal'skaya**

1924 FORCE ACTING ON A CONDUCTING SPHERE IN THE FIELD OF A PARALLEL-PLATE CAPACITOR.
N.N.Lebedev and I.P.Skal'skaya.
Zh. Tekh. Fiz. (USSR), Vol. 32, No. 3, 375-8 (March, 1962). In Russian. English translation in: Soviet Physics-Technical Physics (USA), Vol. 7, No. 3, 268-70 (Sept., 1962).

The electrostatic problem of determining the charge and force on a conducting sphere in contact with one of the plates of a parallel-plate capacitor is treated mathematically and solved.

PA-66-1924

L-14. **Lenard, P.**

Lenard, Philipp.
ON THE ELECTRICITY OF WATERFALLS. [1963]
57p 17refs
Order from SLA $5.60 63-18864

Trans. of [Annalen der Physik] (Germany) 1892, v. 46 [p. 584-636].

DESCRIPTORS: *Atmospheric electricity, Water, Hydrodynamics, Air.

T10-1470

L-15. **Lever, R. C.**

Electrical analysis of paints for electrostatic deposition. R. C. Lever. *Paint Technol.* 27(2), 35–8(1963).

CA 61-4591d

L-16. **Levich, V. G.**

6500* Theory of Coagulation and Settling of Particles of an Aerosol in a Turbulent Stream of Gas. **Coefficient of Entrapment of Aerosol Particles. Teoriia koaguliatsii i osazhdeniia chastits aerozolia v turbulentnom potoke gaza. O koeffitsiente ulavlivaniia chastits aerozolia.** (Russian.) V. G. Levich. *Doklady Akademii Nauk SSSR*, v. 99, no. 6, Dec. 21, 1954, p. 1041-1044.
8 ref.

BMI 4-6500

L-17. Levin, L. M.

Levin, L. M.
ON THE RANDOM ELECTRIFICATION OF CLOUD AND RAINDROPS. [1959] 7p. 7 refs.
Order from LC or SLA ms$1.80, phs$1.80 59-15981

Trans. of Akademiya Nauk SSSR. Izvestiya. [Seriya Geofizicheskaya] 1956, no. 11, p. 1358-1360.

Reasons are presented for believing that the results obtained by R. Gunn (J. Meteorol. 12: 562, 1955) for cloud drops with radius greater than 20μ are erroneous.

T2-413

L-18. Levin, L. M.

2870. THE COAGULATION OF CHARGED CLOUD-DROPS.
L.M.Levin.
Dokl. Akad. Nauk SSSR, Vol 94, No 3, pp. 467-70 (1954). In Russian.
The Langmuir and Shishkin theories of the formation of precipitation are reviewed. The author discusses two oppositely charged drops, and a large charged drop with a smaller uncharged one. It is concluded that for the charged droplets with dimensions of 4 to 30μ the capture coefficient is quite large which ensures coagulation of the droplets. With one droplet very large, compared with another, the effect of their electric charges upon coagulation may be negligible. In rain-drop traps the precipitation on a receiver plate is almost independent of the charges on droplets and on the trap.

TM 4-450

L-19. Levin, L. M.

LEVIN, L. M.
R-3738. The coagulation of charged cloud-droplets and size distribution for cloud-droplets and raindrops. Doklady Akad. Nauk SSSR, 94, no.6, p.1045-1048, 1954. (12p.)

TM 4-186

L-20. Levin, L. M.

LEVIN, L. M.
ATS-92K20R. Precipitation of particles from an aerosol stream on obstacles. Doklady Akad. Nauk SSSR, 91, no.6, p.1325-1332, 1953. (5p.)

TM 4-518

L-21. Levine, S.

5161. The free energy of the double layer of a colloidal particle and the charging process. S. LEVINE. *Proc. Phys. Soc. [London] A*, 66, 357-64 (*April*, 1953).
A detailed analysis is given of the alternative charging processes used by Verwey and Overbeek and the author to determine the free energy associated with the electric double layer of a colloidal particle. A general statistical proof of the equivalence of these methods is obtained. It is shown that the use of the different charging processes is equivalent to assuming an additional, hypothetical, thermodynamic variable to describe the colloidal system: this can be simply interpreted as an arbitrary "chemical" potential of the ions adsorbed on the particle surface. The expression for the free energy derived by Verwey and Overbeek is extended to apply to more general cases, and the treatment by these authors of the so-called chemical energy is clarified.

PA 56-5161

L-22. Levy, J. B., et al

3416. RELATION OF CHARGE TO FRICTIONAL WORK IN THE STATIC ELECTRIFICATION OF FILAMENTS.
J.B.Levy, J.H.Wakelin, W.J.Kauzmann and J.H.Dillon.
Textile res. J., Vol. 28, No. 11, 897-911 (Nov., 1958).
A study of the generation of electrical charge on fibrous materials was carried out using the apparatus of Hersh and Montgomery, in which a fibre is held fixed in an insulated lower yoke while a second fibre in a grounded upper yoke is rubbed across it under controlled ambient and mechanical conditions. The original apparatus was modified to permit measurement of the frictional work of rubbing as well as the charge. Precautions were taken to discharge both fibres with a radioactive source after each measurement. It was found that, at any one velocity, several thousand rubs were required before steady values of charge transferred and frictional work of rubbing were obtained. It was also found that the velocity of rubbing affected strongly both the charge transferred and the frictional work of rubbing, the former being found to decrease and the latter to increase with increasing velocity This has been explained in terms of local heating, plastic junctions, and material transfer which occur during rubbing. An empirical relationship relating the velocity of rub, the frictional work of rubbing, and the charge transferred was found to hold in the great majority of the cases examined. From the experimental data obtained it was possible to calculate the mechanical energy expended in any one rub and to estimate the resulting electrical energy. Thus for any pair of fibres under a given set of conditions it was possible to calculate the efficiency of the process of converting mechanical energy to triboelectrical energy. At 30° C and 33% R.H. measured efficiencies were very low (0.00-0.42%); at a very low humidity, efficiencies as high as 2.0% were found. The presence of a lubricant on the fibre surfaces during rubbing was found in most cases to cause a decrease in both the charge and frictional work of rubbing.

PA-6 -3416

L-23. Lewandowsky, H. G.

"Measurements of the Electrostatic Charge on Smokes." Freiberger Forschungsh, A124, 9-17 (1959). Third Symposium on solid fuels, Dresden, June 26-7, 1958.

L-24. Lewis, W. C. M.

4471. Electric Charge on an Oil Droplet in an Emulsion. W. C. M. Lewis. *Faraday Soc., Trans.* 28. *pp.* 697-607, *July*, 1932.— The total electric charge density on an oil droplet in an emulsion is calculated on the basis of a balance between the inwardly directed capillary pressure and the outwardly directed electrostatic pressure. On the basis of the existence of an electrical double layer of constant dielectric capacity, expressions are obtained essentially the same as those derived by Knapp [see Abstract 1439 (1925)]. The charge density is shown to be independent of the size of the droplet, and a polydisperse system is therefore possible as an equilibrated system. Comparison of the total charge with the mobile charge responsible for electrophoresis shows the latter to be only a very small fraction of the former even under the most favourable conditions for electrophoretic movement. In view of the mechanism postulated in the above treatment for the attainment of charge, *viz.*, by the adsorption of ions from the continuous medium, it is concluded that the treatment does not apply to those cases, *e.g.*, colloidal electrolytes, in which the charge has its origin in surface ionisation of the colloidal material itself. An examination of the air bubble case indicates that the surface conditions are very different from those at an oil/water interface, the electrokinetic or electrophoretic charge apparently accounts for the total charge in the case of the suspended air bubble. An Appendix deals with the pressure inside a liquid droplet suspended in a liquid or gaseous medium.

PA-35-4471

L-25. Lieberman, A. and J. Rosinski

8986 **BEHAVIOR OF AN AEROSOL CLOUD IN A PLASTIC CHAMBER.** A.Lieberman and J.Rosinski.
J. Colloid Sci. (USA), Vol. 17, No. 9, 814-22 (Dec., 1962).

A series of preliminary experiments were performed to determine the effects on the life of an aerosol cloud in a plastic chamber when the walls of the chamber were either coated with an antistatic agent or left uncoated. Measurements were made of the concentration in air particle-size ranges from 1 to 8 μ as a function of time for 10 min. It was concluded that the wall-loss constant for the uncoated chamber changes more rapidly at the beginning of the experiment than later, as a result of changes in the electric-charge distribution on the surface of the uncoated plastic. The possibility of error due to random charge distribution on the surface of the plastic is discussed.

PA 66-8986

L-26. Livenson, A. R.

THE USE OF ULTRASOUND IN AEROSOL THERAPY
17 June 59, 10p. (4 figs. omitted) 9 refs. JPRS: L-803-N.
Order from OTS $0.50 59-13580

Trans. of Meditsinskaya Promyshlennost' SSSR, 1959 [v. 13] no. 1, p. 17-24.

The feasibility of using an ultrasound atomizer for inhalation apparatus is discussed, after a background review of the mechanisms of ultrasonic fog formation. The experimental atomizer used has an ultrasound emitter functioning at a frequency of 800 KC/sec with a power of 45 w. The ultrasound atomizer is roughly 10 times as efficient as the jet atomizer tested for comparison in terms of aerosol density and homogeneity. The aerosol charge is always negative. Reference is made to the use of a concave disk of ceramic barium titanate as a focusing device; this emitter must have an angle of opening not exceeding 60° in order to use the lines of the ultrasound field which sharply converge at the surface of the liquid. Reference is made to ultrasound atomizers manufactured in Belgium and to others produced by "foreign firms". Apparently there are only experimental models available in the USSR. T2-469

L-27. Llewellyn-Jones, F.

"Ionization and Breakdown in Gases."
176 pp., Methuen and Co. Ltd, London, John Wiley and Sons, Inc., New York, 1957.

L-28. Loeb, L. B.

436 STATIC ELECTRIFICATION. II.
L. B. Loeb.
Progress in Dielectrics, Vol. 5 (see Abstr. 22970 of 1963), p. 233-89.

This is the concluding part of a review, continued from Vol. 4 (Abstr. 19873 of 1962). Subjects discussed are homogeneous or symmetrical charging of liquids and solids on dispersion, homogeneous and asymmetrical charging of dusts, static electrification on solid-solid contact, other cases of solid-solid contact electrification, and the basic principles of static elimination. 42 references.

PA-67-436

L-29. Loeb, L. B.

STATIC ELECTRIFICATION. I.
19873 L.B.Loeb.
Progress in dielectrics. Vol. 4, (see Abstr. 17764 of 1962) p. 249-309.

The first part of a comprehensive review of static electrification. The initial sections consider the segregation of charges in the light of atomic structure, states of aggregation, charge transfer, the nature of surfaces, back discharge and manifestations of static charging and charge collection. The types of static electrification are classified. Subsequent sections deal with charging by flow of liquids, streaming potentials, electrical endosmosis and electrophoresis; spray electrification; and gas bubble electrophoresis and the nature of the electrical double layer at gas—liquid interfaces.

PA-65-19873

L-30. Loeb, L. B.

"Basic Processes of Gaseous Electronics" 2nd Edition
Univ. Of California Press, Berkeley, 1960. 1028 pp.

L-31. Loeb, L. B.

3415. **STATIC ELECTRIFICATION.** L.B.Loeb.
Berlin-Göttingen/Heidelberg: Springer-Verlag (1958) xii + 240 pp.
A detailed and often critical account of the phenomena with a comprehensive discussion of recent theoretical interpretations of electrification effects. The following principal subjects are treated in chapters or groups of chapters: electrification by electrolytic processes, contact potential differences, spray electrification, electrification on solid—solid contact and the generation of static charges by processes involving ionization of gases etc. 135 references.

PA-61-3415

L-32. Loeb, L. B.

"Experimental Contributions to the Knowledge of Charge Generation," in Byers, H. R. (Ed.) "Thunderstorm Electricity." Univ. of Chicago Press, Chicago, 1953, pp. 150-192.

L-33. Loeb, L. B.

"Recent Developments in the Mechanisms of Positive and Negative Coronas in Air."
J. App. Physics 19, 882-97 (1948).

L-34. Loeb, L. B.

The basic mechanisms of static electrification. Loeb, L. B. *Science*, 102, 573-6 (*Dec.* 7, 1945).—An examination of the literature shows that the theoretical interpretations put forward to explain static phenomena are frequently inadequate. Five basic mechanisms are discussed, namely electrolytic effects, contact potential mechanisms, spray electrification, friction or tribo phenomena, and the segregation of ions and electrons in gases and flames. It is likely that these basic mechanisms operate together in any particular case, but their separate consideration should help to clarify past results and to guide future work.

PA-49-1075

L-35. Loeb, L. B.

597. *Absolute Mobilities of Negative Ions in Air.* **L. B. Loeb.** (Frank. Inst., J. 196. pp. 537–546, Oct., 1923.)—Although it appears as if the Rutherford alternating-current method of measuring the mobilities of negative ions was capable of yielding the greatest accuracy of any of the methods used, the values of the mobilities thus far obtained by this means show variations which are far greater than are to be expected from the errors entering into the measurement. Thus in some very careful measurements made in 1910 Kovarick found a mobility of negative ions of 2·06 cm./sec. volt/cm.; while the value obtained by Franck and Pohl, and since then by other workers generally lay close to 1·8 cm./sec. More recently the writer found that the mobilities of the negative ions measured directly on photo-electrically generated ions was 2·18 cm./sec., while the mobilities of the negative ions generated by polonium in an auxiliary chamber lay close to 1·84 cm./sec., the conditions being otherwise the same. Investigation showed that the difference in mobility lay in the use of the gauze and auxiliary field and not in the nature of the ionising agent. Various methods are discussed, and it is agreed that the Rutherford method with photoelectric ions is free from many uncertainties prevalent with the others. The experimental arrangement used is described. Its chief defect appears to be the difficulty of obtaining strict parallelism of the plates. The value of the mobility now obtained in fields varying from 12·5 volts to 50 volts/cm., in frequencies varying from 14 cycles per sec. to 75 cycles per sec., and with plate distance lying between 1·4 and 2 cm., at 760 mm. pressure is 2·18 cm./sec. volt/cm. The greatest uncertainties lie in the evaluation of the plate distance where the plates are not quite parallel. This introduces an uncertainty of ± 3 per cent. The estimation of the voltage intercept is not certain to an accuracy greater than 0·3 volt. Errors of ± 1 per cent. due to timing, of from 0 to ± 2 per cent. on account of the distance gone as an electron and perhaps of ± 2 per cent. in the conversion and correction of the potentials between the plates must also be considered. Taking into account the variety of conditions under which these results are obtained, the mobility of the negative ion may be stated as 2·18 ± 0·04 cm./sec. volt/cm. in place of the value of 1·8 cm./sec. usually assigned to it. Other work is in progress.

PA-27-597

L-36. Lorenz, P. J.

11619 **AIR-ION DENSITIES IN A SMOKE-FILLED ROOM.**
P.J.Lorenz.
Proc. Iowa Acad. Sci. (USA), Vol. 68, 452-60 (1961).
This study was concerned with the differentiation and measurement of small, intermediate, and large ion densities in a sealed room. It was found that the background density of large negative ions exceeded that of any other class. Under conditions of tobacco smoke pollution, large ions of both positive and negative charge were the major components of the air-ion population. This was accompanied by a persistent attrition of high mobility ions both during and after smoking.

PA-65-11619

L-37. Lovera, G.

3223. Electrification of Drops. G. Lovera. *N. Cimento*, 15. *pp.* 609–614. *Dec.*, 1938.—A *résumé* is given of observations since 1895 [see Abstract 1494 (1899)] on the electrification produced in the air surrounding waterfalls and on that noticed when the surface of various liquids is broken. Lenard's theory of the double layer is referred to [see Abstract 1446 (1915)] but the author of the summary regards the subject as a thorny and difficult one which requires further cautious experiment and observation.

PA-42-3223

L-38. Lovera, G. and A. Pochettino

553. Frictional electricity from polar solutions. G. Lovera and A. Pochettino. *N. Cimento*, 16, *pp.* 337–347, *July*, 1939.—An extension of previous work by the same authors [see Abstract 1317 (1938)]. A mist of liquid suspended in an atmosphere of N_2 at 60 mm. Hg is circulated so that it passes between plates connected to an electrometer. The frictional charge is measured by the rate of increase of voltage. The liquids used were dioxane, benzene, xylene and toluene, and solutions in them of hydrocarbons of appreciable dipole moment. Tables and curves of results are given in detail. The charges were found to depend on the dipole moment. In every case an increase of dipole moment caused an increase of charge. Positive and negative charges were unequal, and the ratio (positive charge)/(negative charge) was inversely proportional to the dipole moment. Lenard's hypothesis of frictional charges arising from a double layer is held to be disproved, for the present liquids. Instead it is suggested that the liquids have superficially a crystalline structure, and that frictional charges are generated when the crystals are fractured. PA-43-553

L-39. Lovera, G. and A. Pochettino

1317. Electrification of Liquid Droplets. G. Lovera and A. Pochettino. *N. Cimento*, 14. *pp.* 393–410. *Nov.*, 1937.—When a stream of N_2 was blown through a solution of an organic salt, the droplets of liquid, passed between two electrodes connected to a Lindemann electrometer, were found to be charged both positively and negatively. The magnitude of the charge varied with the rate of flow of the gas and with the concentration of the solution. The form of the curves of charge against concentration is different for positive and negative charges, and has a number of points, characteristic of the salt, at which the positive and negative charges are equal. For methylene blue and quinine bisulphate there are two such points, and for uranin there is one. PA-41-1317

L-40. Lowe, H. J. and D. H. Lucas

3435. The physics of electrostatic precipitation. H. J. Lowe and D. H. Lucas. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S40–S46 (1953).

Summarizes the existing theories of the behaviour of particles in an electric field with special reference to the electrostatic precipitation of flue dust in power stations burning pulverized coal. The theoretical relation between particle size and precipitation efficiency is not borne out in practice and an endeavour is made to resolve the discrepancy by considering the molecular and electric forces acting on particles after they have been deposited on the collecting electrodes.

PA-57-3435

L-41. Luchak, G.

Theory of the electric-charge distribution of monodispersed lightly-charged aerosols of spherical particles coagulating in a bipolar ionized atmosphere. George Luchak (Defence Research Board Canada, Ralston, Alberta). *J. Colloid Sci.* 12, 144–60(1957).

Equations describing the changes with time of the electric charge distribution of coagulating aerosols are solved for lightly charged systems. The solutions are compared with experimental data from the literature on the electric charge distribution of initially uncharged ammonium chloride aerosols and good agreement is obtained. The theory is used to describe qualitatively the change in electric charge distribution of silica dusts previously studied experimentally by Gillespie.

Author

L-42. Lunde, K. E. and C. E. Lapple

"Dust and Mist Collection."
Chem. Engr. Progress 53, No. 8, 385-91 (1957).

L-43. Lundgren, D. A.

"The Effect of Particle Electrostatic Charge on Filtration by Fibrous Filters," M. S. Thesis, University of Minn., March, 1962.

L-44. Lundgren, D. A. and K. T. Whitby

The effect of particle electrostatic charge on filtration by fibrous filters. D. A. Lundgren (Gen. Mills Electron. Div., Minneapolis, Minn.) and K. T. Whitby. *Am. Chem. Soc., Div. Water Waste Chem., Preprints* 1962(Sept.), 21–4.

CA 61-320f

L-45. Luther, F. E.

Luther, F. E., "Electrostatic Atomization of No. 2 Fuel Oil," *API Res. Conf. on Distill. Fuel Combust. Proc.*, (1962), API Pub. 1701.

An electrostatic atomizer for No. 2 fuel oil developed. 40 micron MMD and up reported, where MMD is directly proportional to flow rate. A cone and ring electrode configuration used. Effect of using DC voltage, AC voltage and a combination of them examined.

Author

L-46. Lyubimov, G. A.

Lyubimov, G. A.
BOUNDARY CONDITIONS ON IONIZED GAS-SOLID CONTACT SURFACE. 23 Mar 64 [13p] 7refs FTD-TT-64-128.
Order from OTS, SLA, or ETC $1.60 TT-64-15238

Unedited rough draft transl. of [Zhurnal] Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (USSR) 1963, no. 4, p. 78-82. T12-43

M-1. Mackeown, S. S., and V. Wouk

"Electrical Charges Produced by Flowing Gasoline," Ind. Eng. Chem. 34, No. 6, 659-664 (1942).

M-2. Macky, W. A.

1318. Deformation and Breaking of Water Drops in Strong Electric Fields. W. A. Macky. *Roy. Soc., Proc.* **133.** *pp.* **565–587,** *Oct.* **1, 1931.**—Drops of water of radius (r) 0·085–0·26 cm., exposed to an increasing electric field, horizontal or vertical, first become elongated (for this in the case of the largest drops a field of at least 5000 V/cm. is required), and when the field strength rises to $3875/\sqrt{r}$ V/cm., unstable. A filament then forms at each end, much larger at the positive, and a discharge passes, a glow or spark being visible in the dark, the luminous effects being such as are characteristic of positive or negative point discharges; the current first passing is of the order of 20 microamperes. When the discharge passes small drops pass away from the filament, thus reducing the size of the drops. In this way the maximum size of drops in a thunderstorm would be limited, as *e.g.*, no drop of $r > 0{\cdot}15$ cm. can persist in a field of 9000 V/cm. Reduction of pressure, unless near such as causes a spark to pass in absence of a drop, has no effect. [See Abstract 4070 (1930).]

PA-35-1318

M-3. Macky, W. A.

4070. Deformation of Soap Bubbles in Electric Fields. W. A. Macky. *Cambridge Phil. Soc., Proc.* **26.** *pp.* **421–428,** *July,* **1930.**

The method is similar to that used by C. T. R. Wilson and G. I. Taylor [see Abstract 2331 (1925)], save that both plates are connected to the poles of a Wimshurst machine, the potential being adjusted by varying the distance of a point on the negative plate; and that instead of the bubble being placed directly on the wetted plate a shallow cavity was made in the lower plate and the bubble placed on soap solution contained therein. The phenomena are similar to those previously observed until the field is sufficient to cause vibration, the strength for which is the same for a positive or negative bubble, varying inversely as its radius. Thereafter the positive bubble always bursts quickly, but the negative bubble does not usually do so until some protuberance (*e.g.*, splashed soap solution) on the positive plate causes a spark to pass. Photographs of bubbles in various stages are given. Preliminary experiments with water drops indicate that these are distorted in a very similar manner, and that a drop of radius 0·18 cm. is disrupted by a field of about 9000 volts/cm.

PA-33-4070

M-4. Macky, W. A.

2162. Quantitative Measurements in Frictional Electricity. W. A. Macky. *Roy. Soc., Proc.* **119.** *pp.* **107–132,** *May* **1, 1928.**

Two substances are rubbed together under definite conditions, and the resulting charge is measured. Only minute charges are obtained as the result of simple contact. For given specimens the charge increases with the amount of rubbing, up to a fairly definite maximum. The dielectric strength of the medium in which the experiment is performed is shown to be a very important factor. The experiments do not support the Helmholtz contact theory or Coehn's relation between charge and dielectric constant. References are given to a great deal of recent work on frictional electricity. [See also Abstract 1671 (1928).]

PA-31-2162

M-5. Macleod, G. F., and L. M. Smith

"Deposits of Insecticidal Dusts and Diluents on Charged Plates," J. Agr. Research 66, 87-95 (1942).

M-6. Magarvey, R. H., and B. L. Blackford

15877 EXPERIMENTAL DETERMINATION OF THE CHARGE INDUCED ON WATER DROPS.
R.H.Magarvey and B.L.Blackford.
J. geophys. Res. (USA), Vol. 67, No. 4, 1421-6 (April, 1962).

Charges induced on drops formed by dispensing small masses from a source liquid in the region of an electrostatic field were measured. The induced charge was found to be proportional to the voltage applied to a ring electrode positioned coaxially with the liquid jet from which the drops were formed. The measured values were in good agreement with theoretical predictions. Charges induced on drops in a regular procession were calculated from current measurements and the drop production frequency. The charge transported by the drops was read directly from a calibrated meter.

PA-65-15877

M-7. Magarvey, R. H., and L. E. Outhouse

"Note on the Breakup of a Charged Liquid Jet," J. Fluid Mech. 13, 151-157 (1962)

The disintegration of a charged liquid jet is examined, and the break-up mechanism inferred from photographic evidence. Gravitational, molecular and electrical forces all contribute to the segmentation of the jet and determine the drop size distribution. The disintegration process is investigated from the point of view of drop generation. The segmentation of the charged jet differs from the known ways in which an uncharged jet is broken into drops.

Author

M-8. Magono, C., and T. Takahashi

6865. THE ELECTRIC CHARGE ON CONDENSATE AND WATER DROPLETS. C.Magono and T.Takahashi.
J. Meteorol., Vol. 16, No. 2, 167-72 (April, 1959).

It was found that dew produced artificially on a thin wire was electrified negatively when the water temperature of the reservoir for supplying water vapour was lower than about 80°C, and positively when the temperature was higher than about 85°C. The electrification phenomena of the condensate were considered to be originated from the electric charge on individual water droplets, because it was observed that the droplets were electrified when they rose from the water surface of the reservoir, and the sign of charge on the individual droplets agreed well with that of the condensate.

PA-61-6865

M-9. Mainstone, P. A.

1539. Factors Governing the Magnitude of Frictional Electric Charges. P. A. Mainstone. *Phil. Mag.* 8, *pp.* 733–749, *Nov.*, 1929.

The investigations of other observers are summarised. The apparatus used was of two types designed to obtain reasonably constant conditions in measuring the results due to very small amounts of mechanical work, and is fully described and illustrated. The materials used were brass, steel and silver, in each case in rubbing contact with glass, and experiments were conducted in air, hydrogen, nitrogen, and (in the case of silver) in oxygen, at pressures varying from a few mm. up to atmospheric pressure. The results (a number of which are demonstrated graphically) appear to show that: (1) Where a glass surface is rubbed on metal the charge shows marked variation with pressure, being a minimum over a range of about 1 to 10 mm. (2) At higher pressures the charge varies with the gas. (3) Variation of charge with pressure is independent of the capacity of the system.

PA-33-1539

M-10. Makhotkin, L. G.

CHANGE IN THE CHARGES ON DROPS DURING EVAPORATION. [1960] 3p.
Order from ATS $4. 25 ATS-39N48R

Trans. of Glavnaya Geofiz[icheskaya] Observatoriya [Leningrad]. Trudy (USSR) 1960, no. 97, p. 48-50.

T5-410

M-11. Malan, D. J., and B. F. J. Schonland

"Charge Distribution and Electrical Processes Deduced from Lightning Measurements," Byers, H. R. (Ed.) "Thunderstorm Electricity," Univ. of Chicago Press, Chicago, pp. 238-250 (1953).

M-12. Malarski, T.

1850. Influence of Electrolytes on Electrification of Water by Atomisation. T. Malarski. *Acta Physica Polonica*, 3. *pp.* 43–74, 1934. *In German.*—The influence of thorium nitrate, thorium sulphate, aluminium chloride, aluminium sulphate, barium chloride and potassium chloride on the electrification of water by atomisation, was investigated. The water and solutions were atomised by means of compressed air, the atomised water was allowed to impinge on a platinum plate which was connected with a quadrant electrometer. The results showed that the potential to which the plate connected to the electrometer was charged, depended to a very large extent on the method of preparation and storage of the water. Water distilled from a vessel of Jena glass and a silver condenser gave a much lower deflection of the electrometer than water distilled in an apparatus made of quartz. Curves were given, showing the effects of the various electrolytes on the atomisation potential of water.

PA-38-1850

M-13. Mason, B. J.

Charge generation in thunderstorms. B. J. Mason (Univ. London). *Endeavour* 21, 156-63(1962).

CA-58-4335c

M-14. Mason, B. J.

"The Physics of Clouds," Oxford University Press (1957)

M-15. Mason, B. J., and J. Maybank

20832 THE FRAGMENTATION AND ELECTRIFICATION OF FREEZING WATER DROPS. B.J.Mason and J.Maybank. Quart. J. Roy. Meteorol. Soc. (GB), Vol. 86, 176-85 (April, 1960).

The freezing of water drops is often accompanied by shattering of the ice shell and the production of small ice splinters. These phenomena have been studied in relation to the drop diameter in the range 30 μ to 1 mm, the nucleation temperature of the drop, the air content and purity of the water. The number of splinters produced is largely governed by the nucleation temperature (the degree of supercooling) which controls the quantity of air released during freezing and is not very dependent on drop size. Slightly supercooled drops of 1/10 to 1 mm diamater produced, on average, 20 to 50 splinters. The mechanism of drop fragmentation is discussed and the potential importance of splintering in the ice-nucleus economy of clouds is assessed. Fragmentation of freezing drops is accompanied by electrical charging, usually with the splinters positively charged and the drop residue carrying a negative charge. The magnitude of the residual charge which, on average, is observed to be about 10^{-3} e.s.u. for a millimetre drop, is related to the same factors which control splinter production. Charging by this mechanism would not appear to be of major importance in the electrification of thunderstorms.

PA-64-20832

M-16. Masters, J.

8744. An aerosol analyzer. J. I. MASTERS. *Rev. sci. Instrum.*, 24, 586–8 (*Aug.*, 1953).

Described is a simple device for measuring the total mass and total charge of a powder cloud. The instrument consists of a sensitive electrometer circuit and a metallic collection chamber. The powder is collected on a filter paper sealed between two aluminium tubes which, if their lengths are three times greater than their diameter, provides sufficient shielding of the charge collected on the filter paper to justify assumption of an "Ice Pail." The shielding error is less than 0·5%. A null-reading circuit is used with a Cenco electrometer. The necessary counter voltage for the null-reading circuit is supplied by a potentiometer circuit, and a vacuum-tube voltmeter is used to measure the voltage. Because it is desired to obtain

explicitly the mass and charge of a given cloud of particles rather than the ratio of charge to mass, enough mass must be collected for weighing and, in addition, the total charge measured. This is to be accomplished without disturbing appreciably the normal flow rate of powder from the aerosol generator.

PA-56-8744

M-17. McTaggart, H. A.

114. *Electrification at the Boundary between a Liquid and a Gas.* H. A. McTaggart. (Phil. Mag. 44. pp. 386-396, Aug., 1922.)—In continuation of previous work [see Abs. 1910 (1914)] the author has investigated the electric charges on small spheres of air immersed in an aqueous solution of thorium nitrate. The spheres become positively charged in solutions of the salt as dilute as 8×10^{-6} normal. For concentrations in the neighbourhood of 6×10^{-6} normal, a sphere initially negatively charged becomes gradually positively charged as the sphere decreases in size. A sphere of air immersed in colloidal thorium hydroxide becomes likewise positively charged, and the same reversal of sign of the charge is shown as the bubble decreases in size. It is suggested that the reversal of sign affords evidence of a relation between the curvature of the surface and its adsorptive power.

PA-26-114

M-18. Medley, J. A.

3421. The electrostatic charging of some polymers by mercury. J. A. Medley. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 28–S 30 (1953).

A method is described by which very heavy charge densities may be measured after separation. The influence of externally applied fields on the apparent electrification is described, and also the electrostatic contribution to hysteresis of contact angle.

PA-57-3421

M-19. Medley, J. A.

3418. The dissipation of electrical charges generated by rollers. J. A. Medley. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 23–S 27 (1953).

It is shown that over a large range of roller pressures, gaseous discharge imposes an upper limit to the charge density of clean, poorly conducting wool cloth or rovings; this can be further reduced by conductors auxiliary to the rollers and designed to concentrate locally the lines of force. Dissipation by conduction back through the material to the point of contact is distinguished from discharge through surface contaminant, which behaves as a leaky dielectric in the region of contact. It is confirmed experimentally that electrification rapidly disappears as the bulk conductivity of a surface agent attains a calculable critical value in practice of the order of $10^{-9}\ \Omega^{-1}\ cm^{-1}$ or, where the material itself conducts, as a parameter K approaches unity; K may be defined for fibre assemblies as well as for homogeneous materials in terms of speed, external dimensions and a directly measurable resistance.

PA-57-3418

M-20. Mercer, T. T.

"Charging and Precipitation Characteristics of Sub-Micron Particles in the Rohmann Electrostatic Particle Separator," Univ. Rochester, AEC Proj. UR-475 (1956).

Sodium chloride particles of sub-micron dimensions, moving in a unipolar ion field, in a region in which there was an externally applied electric field of about 3×10^3 volts/cm., for a period of time such that the product of ion density and time was about 3×10^5 sec./cm.^{3}, were found to acquire charges that were much greater than those calculated according to the theories of field charging and diffusion charging. The discrepancies between theoretical and experimental values were apparently due in part to the fact that present equations based on diffusion theory are not applicable to initially high charging rates.

The relationship between charge and particle size, for the foregoing charging conditions, was found to be such that the velocities acquired by charged sodium chloride particles due to a homogeneous electric field were at a minimum for particles of about 0.2 micron on a side. Furthermore, for the limited range of sizes studied (few sodium chloride particles greater than 1 micron on a side were encountered) there was only a slow increase in the electrical velocity as the particle size increased beyong 0.2 micron.

It was concluded that the separation of sub-micron particles into discrete size groups by electrostatic means is not generally feasible.

Author

M-21. Messen-Jaschin, G. A.

Apparatus for electrostatic charging of particles suspended in an air stream by means of a radioactive cartridge. Firma G. A. Messen-Jaschin. Swiss 343,369, Feb. 15, 1960 (Cl. 12*e*).

CA-54-19236b

M-22. Metnieks, A. L., and L. W. Pollak

N62-14252 Institute for Advanced Studies. School of Cosmic Physics, Dublin (Eire).
TABLES AND GRAPHS FOR USE IN AEROSOL PHYSICS. PART II: NUMBER OF UNCHARGED PARTICLES IN PERCENT OF TOTAL NUMBER OF PARTICLES V. RADIUS AND VICE VERSA. Technical (Scientific) Note no. 15.
A. L. Metnieks and L. W. Pollak. Dec. 1961. 50 p. 4 refs.
(Contract AF 61(052)-26)
(Its Geophysical Bulletin no. 20; AFCRL-62-616)

For comparative simplicity of measuring the unchanged fraction of an aerosol, the tables give for temperatures of 0°, 15°, 20°, and 25° C the number of uncharged particles, F, in percent of the total number of particles for the radii $r = 0.5 \times 10^{-6}$ to 109.0×10^{-6}, 0.1×10^{-6}, and 1.0×10^{-6} respectively and the radii as a function of F for each tenth of a percent.

N 62-14252

M-23. Meyer, K. A. G.

Results of aerosol research in science and engineering 1932–1942. I. MEYER, K. A. G. *Kolloidzschr.*, 102, *pp.* 293–298, *March*, 1943.—A progress review of scientific research on aerosols, with an extensive bibliography. PA-48-1102

M-24. Mierdel, G.

762. Migration of Dust Particles in Electric Filters. G. Mierdel. *Zeits. f. techn. Physik*, 13. 11. *pp.* 564–567, 1932. *Phys. Zeits.* 33. *pp.* 823–824, *Nov.* 1, 1932.—Studies the behaviour of ions, particularly in "tube filters." They are metallic tubes about 25 cm. in dia. and several metres in length, along the axis of which a wire charged to some 60 volts is fixed, while the tube itself is earthed. The air to be cleaned is made to stream along the tube with a speed of 1 to 3 m./sec. The author determines the migration velocity for nuclei of various sizes, and finds them to range from 80 cm./sec. for particles of 60 to 75 μ to 4·9 cm./sec. for particles of 0·2 μ. These velocities correspond so closely to theory that it is unnecessary to assume any action beyond the ordinary electrostatic action in calculating the efficiency of the apparatus.

PA-36-762

M-25. Mierdel, G., and R. Seeliger

"The Physical Basis of Electrical Gas Purification," Trans. Far. Soc., 32, 1284-89 (April, 1936).

M-26. Miesse, C. C.

M-26. Miesse, C. C.

14421 Recent Advances in Spray Technology. C. C. Miesse. *Applied Mechanics Reviews*, v. 9, Aug. 1956, p. 321-323.

Reviews investigations of droplet formation, stream penetration, secondary atomization, evaporation, and ballistics. Applications to atomization of fuels.

BMI 5-14421

M-27. Milhoud, A.

2644. E.M.F. Produced by Flow of Water Vapour. A. Milhoud. *Comptes Rendus*, 198. *pp.* 1586–1589, *April* 30, 1934.—Experiments are described to find the e.m.f. produced when water vapour is driven through tubes of glass or other material under pressure. With tubes of uniform cross-section, it was found that the e.m.f. developed was proportional to the initial pressure. Using tubes of insulating material converging to a neck and then diverging again it was found that no e.m.f. was produced until the pressure was sufficient to produce turbulent flow. Above this critical pressure the voltage rose rapidly and reached some thousands of volts. The voltage was found to be proportional to the difference between the inlet and outlet pressures. The presence of droplets of water in the vapour appears to be essential, as it was found that superheating to 130° C. completely eliminated the electrification.

PA-37-2644

M-28. Miller, J. G.; H. Heinemann, and W. S. W. McCarter

The static electrification of dust clouds. John G. Miller, Heinz Heinemann, and W. S. W. McCarter (Attapulgus Clay Co., Philadelphia, Pa.). *Science* 107, 144 (1948).

CA-42-5157f

M-29. Millikan, J. A.

"Coefficients of Slip in Gases and the Law of Reflection of Molecules from the Surfaces of Solids and Liquids," Phys. Rev., 21, 217-238 (1923).

M-30. Min, K; B. T. Chao; M. E. Wyman

"Measurement of Electrostatic Charge on Solid Particles in Solid-Gas Suspension Flow," Rev. Sci. Instr., 34, No. 5, 529-531 (May, 1963).

A method for measuring the charge spectrum of particles in a solid-gas suspension flow is described. The probe, fabricated of hypodermic needle, gives minimal disturbance to the flow stream. The charge spectrum is obtained by a pulse counting technique. Typical results are presented for glass particles of 80 μ diameter in air stream flowing at 8 m/sec inside an aluminum channel. The charge distribution follows essentially an exponential law and the average charge per particle has been found to be 1.3×10^{-14} C. Practically all particles carried a measurable charge.

Author

M-31. Moiseyev, Ye. V.

"Charging Solid Particles and Drops in an Electric Field," Referativnyy Zh. Khimiya, 15, 55-57 (1961). Translation available: AD 402 469.

The electrical charge of solid particles or drops of paint in contact charging is achieved as a result of raising the voltage of the power source, of using material with high electrical conductance, of sharp rounding of the atomizer, and of decreasing the thickness of the layer of material on the edge of the electrode. Since certain variables simultaneously influence the size of the charge it is necessary strictly to maintain the technological regime according to the voltage, paint flow rate, and electrical parameters of the material.

Author

M-32. Moll, W. L. H.

22. Recent Work on Aerosols (Dust, Smoke, Fog). W. L. H. Moll. *Kolloid Zeits.* 81. *pp.* 225–234, *Nov.*, 1937.—The author gives a very complete survey of work dealing with aerosols during 1934–36, and first collects together the most important scientific results under the following sections: General properties of aerosols; preparation methods, analysis (particle-number, -concentration, -magnitude, electrical and optical properties); coagulation (in the gravitational, electrical, acoustical and thermal fields); absorption of fogs in liquids; meteorology; dust in industry (survey of various industries, flue gases, dust explosions, gas purification); fog removing agents; filters. A very complete Bibliography of 220 references contains publications on aerosols exclusive of dissertations, patents, and popular articles, and is arranged alphabetically according to the authors' names.

PA-41-22

M-33. Moncrieff, R. W.

"Can Smell Be Detected Other than by the Nose?" American Perfumer, 47, No. 5, 41-43 (May 1945).

M-34. Montgomery, D. J. et al.

4549 STATIC ELECTRIFICATION OF FILAMENTS: EFFECT OF FILAMENT DIAMETER.
D.J.Montgomery, A.E.Smith and E.H.Wintermute.
Textile res. J. (USA), Vol. 31, No. 1, 25-31 (Jan., 1961).

A study was made of the effect of filament diameter on the charge transferred between filaments rubbed together under controlled ambient and mechanical conditions. Filaments of various diameters and of medium resistivity (nylon, ~ 10^{13} ohm cm) were rubbed against a filament of low resistivity (tantalum, ~ 10^{-5} ohm cm) and one of high resistivity (polyethylene, ~ 10^{15} ohm cm) at different normal forces between the filaments. For nylon against tantalum, the charge transferred was found to be proportional to the square root of the product of the diameter and the normal force between the filaments. For nylon against polyethylene, the charge transferred was found to be proportional to the square root of the normal force, but nearly independent of the diameter. These findings are consistent with the hypothesis that the charge transferred is proportional to the true area of contact (that is, the area over which interpretation of molecular fields occurs) swept out on the object of lower conductivity.

PA 64-4549

M-35. Moore, C. B., and B. Vonnegut

"Estimates of Raindrop Collection Efficiencies in Electrified Clouds," Physics of Precipitation, (book) Geophysical Monograph No. 5, American Geophysical Union (1960).

M-36. Morikawa, M.

2931 CALCULATION OF AXIALLY SYMMETRIC ELECTROSTATIC FIELDS FOR TWO COAXIAL EQUIDIAMETER CYLINDERS. M. Morikawa.
J. Appl. Phys. (USA), Vol. 34, No. 11, 3179-81 (Nov. 1963).

A method is given for calculating the potential distribution of a system consisting of two coaxial cylinders, each of unit radius, separated by a distance of 2a along the axis. The potentials of the left- and right-hand cylinders are taken as −1 and +1, respectively. The problem can be solved if the potential $\phi(1, z)$ on $r = 1$ or its inverse Fourier sine transform $A(\lambda)$ is obtained. The dual integral equations for $A(\lambda)$ are derived from the boundary condition on the cylinders and the continuity condition of the potential and of its normal derivative on the gap ($r = 1, |z| \leq a$) between the cylinders. The solution $A(\lambda)$ is expressed by the following series:

$$A(\lambda) = \frac{2}{\pi}\frac{J_0(\lambda a)}{\lambda} + \sum_{n=1} \frac{a_n J_{2n}(\lambda a)}{\lambda}.$$

The coefficients a_n in this series satisfy an infinite set of linear equations. The values of a_n for several values of the half-gap length a are calculated by successive approximations and are shown in a table.

PA-67-2931

M-37. Morris, G.

3428. The ignition of explosives by condenser discharges—effect of added circuit resistance. G. Morris. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 97–S 100 (1953).

To investigate the mechanism of ignition of explosives by capacitance sparks, the critical ignition energy of lead trinitroresorcinate was examined for a wide range of capacitance and series resistance. The experimental data do not completely conform to the same energy/time relation as for ignition by hot wires. A useful empirical relation is, however, found. The use of added resistance ... earth lines is shown to decrease plant safety.

PA-57-3428

M-38. Morris, G.

249. Electrification of powders by free fall. G. Morris. *Phys. Soc., Proc.*, **51**, *pp.* 1010–1013, *Nov.*, 1939.—The electrification of insulating powders due to free fall has been examined quantitatively. For a given powder the quantity of electricity generated is found to be proportional to the square root of the product of the height of fall and the weight of powder. It is independent of the nature of the surface of the receiving vessel, and of the capacitance of the measuring system. Under given conditions of fall the quantity of electricity generated increases rapidly as the fineness of the powder is increased.

PA-43-249

M-39. Morton, W. B.

1416. *Electrification of Two Intersecting Planes.* **W. B. Morton.** (Phil. Mag. 1. pp. 337–348, Feb., 1926.)—The two-dimensional problem of finite breadth, but of infinite length in the direction of their intersection, is solved by Schwarz's method of conformal representation. The differential equation expressing the transformation is found to be integrable, so that the coordinates of a point in the electric field can be simply expressed in terms of the logarithmic potential and the line of force function. With reference to the distribution of the charge, it is shown that half of the entire charge is borne on the outer side of one plane together with the inner side of the other. When the two planes have equal breadths and are inclined at angle $(\pi - \gamma)$ the charge on the convex side is to that on the concave side in the ratio of $\frac{1}{2}\pi + \sin^{-1}(\gamma/\pi)$ to $\frac{1}{2}\pi - \sin^{-1}(\gamma/\pi)$. When the planes are equal and at right angles the outer charge is double the inner.

PA-29-1416

M-40. Moureau-Hanot, M.

*3021. Transport of Electric Charges by Droplets. M. Moureau-Hanot. *Comptes Rendus*, 208, pp. 1492-1494, *May* 8, 1939.—Advantages of replacing the solid particles in an electrostatic generator working with a current of gas [see Abstract 3255 (1937)] by liquid droplets are summarised, and experiments are described with an apparatus using droplets of a mixture of CCl_4 and vaseline. In an apparatus of four ionisers properly designed, each drop would be charged or discharged 16 times on an average before striking the walls. To obtain 500 μA, 100 cm³. must be atomised per min., the drops being 1 μ in radius. The process is thus capable of supplying a reasonable current. PA-42-3021

M-41. Muchnik, V. M.

Muchnik, V.M.
CHAIN PROCESS OF ACCUMULATIONS OF CHARGE IN THUNDERCLOUDS (Tsepnoy Protsess Nakopleniya Zaryadov v Grozovykh Oblakakh). [1958] 4p. 5 refs. F-TS-9555/III.
Order from LC or SLA mi $1.80, ph $1.80
59-12169

Trans. of Akademiya Nauk SSSR. Doklady, 1954, v. 99, no. 4, p. 537-538.

When drops of water break up, a division of the charges induced on the drops occurs. Droplets have a positive charge, while water spray has a negative charge. The positively charged droplets of the liquid-drop region intensify the original field, while the negatively charged water spray is carried upward by air currents. Very high charges are formed which when transported to a liquid drop region, intensify the charge and the field under it. This process of accumulation of charges in a cloud proceeds with constantly increasing speed and sustains itself in a chain process. The accumulation of charges and the consequent increase in the potential of the field in thunderclouds does not take place linearly but at a constantly increasing rate in accordance with an exponential law. A thundercloud may be considered to be a self-exciting generator in which a chain process of the accumulation of charges occurs.

T1-97

M-42. Muchnik, V. M.

8379. Ionization by the break-up of drops in an electric field. V. M. MUCHNIK. *Zh. eksper. teor. Fiz.*, 26, *No.* 1, 109–14 (1954) *In Russian.*

An experimental study of water drops of 0·6 cm diameter in a vertical stream of air in a field of the order of 170 V/cm. On breaking-up ions were formed and were registered as light and heavy ions by an electrometer. For the break-up of one drop 10^3 light ions and $2{\cdot}1 \times 10^6$ heavy ions were formed; the corresponding total charges were -5×10^{-5} and $-1{\cdot}0$ e.s.u. Experiments were also performed on the variation of the charge produced as a function of the field and it was shown to be directly proportional to the applied field.

PA-57-8379

M-42.(Continued)

Muchnik, V. M.
IONIZATION DURING SHATTERING OF DROPS IN AN ELECTRIC FIELD. Appendix C-14. [1959] [11]p. 6 refs.
Order from LC or SLA mi$2.40, ph$3.30 59-20370

Trans. of [Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki] (USSR) 1954, v. 26, no. 1, p. 109-114.

Ionization is shown to be proportional to electric field intensity. New experimental data are obtained for ionization under the balloelectric effect.

T2-893

M-43 Mühleisen, R.

2712. ELECTRIC CHARGES ON CONDENSATION NUCLEI WHEN WATER VAPOUR IS ABSORBED OR GIVEN OFF. R.Mühleisen. Naturwissenschaften, Vol. 45, No. 2, 34-5 (1958). In German.

Experimental results show that when the water vapour content of the air in a large hall of volume 400 m^3 was increased, there existed a negative space charge of about 1000 elementary charges per cm^3. Heating the air caused the space charge to become a positive one of about the same magnitude. These results and their relation to meteorological observations, such as the morning increase in the fine-weather field, are briefly discussed.

PA-61-2712

M-44. Mühleisen, R., and W. Holl

4516. A new method of measuring the electrical space charge density of the air. R. MÜHLEISEN AND W. HOLL. *Geofis. pura appl.*, 22, 189–94 (*April–June*, 1952) *In German.*

A waterdrop, falling from an earthed injection-needle within an earthed screening-cage is influenced by the electric space charge of the surrounding air. The drop therefore leaves the point with a true electric charge proportional to the space charge of the air. A method for measuring electric charge on water drops is described. Recording of the space charge is possible to a sensitivity of about ± 10 electronic charges/cm^3. Volta potentials cause a zero uncertainty of ± 25 electronic-charges/cm^3. Three measurements can be made in a second.

PA-56-4516

M-45. Müller, A.

"Electrostatic Particle Containment," Ann.d. Physik 7, Folge, Band 6, S206 (1960).

M-46. Müller-Hillebrand, D.

5799. Charge generation in thunderstorms by collision of ice crystals with graupel, falling through a vertical electric field. D. MÜLLER-HILLEBRAND. *Tellus*, 6, *No.* 4, 367–81 (*Nov.*, 1954).

When an ice-crystal impinges on the lower surface of a particle of hail or soft hail part of the charge induced by the electric field is transmitted to the ice-crystal. The relaxation time for the exchange of charge varies from a few milliseconds to about 10^{-6} seconds and is sufficiently short to enable this gain of charge. In a positive field the soft hail will therefore get a negative and the ice-crystal a positive charge. In an electric field E the final charge of a sphere with a radius R is $e_\infty = -2{\cdot}12ER^2$. At temperatures between −18 and −26° the number of ice crystals is sufficient to allow a time constant of about 5 minutes for the charging process. The charge per droplet and per g. of water derived from this process are in good agreement with measurements of Ross Gunn. The growth of precipitate and the formation of strong electric fields can be brought into correspondence with the timing and development of thunderstorms.

PA-58-5799

M-47. Müller-Hillebrand, D.

1408. Limitations of the Wilson thunderstorm theory. D. MÜLLER-HILLEBRAND. *Ark. Geofys.*, 2, *Paper* 11, 227–44 (1954).

A critical investigation is presented of the charging mechanism of thunderclouds first suggested by C. T. R. Wilson. The relative magnitudes are determined of the charges accumulated by droplets polarized in a weak electric field and of the simultaneous diffusion process. It is argued that the Wilson process can only operate during a limited period of the life cycle of a thundercloud. It is furthermore shown that the rate of charge generation according to the Wilson mechanism is too slow and the magnitude of the charge generated too small to account for the charges involved in the mature state of a thundercloud. See also preceding abstract.

PA-58-1408

M-48. Müller-Hillebrand, D.

1407. The ion capture on polarised drops. D. MÜLLER-HILLEBRAND. *Ark. Geofys.*, 2, *No.* 10, 197–225 (1954).

A detailed mathematical investigation of Wilson's theory of the charge acquired by a water drop moving in an electric field. Ion paths in the vicinity of the drop are calculated for both stationary and slowly moving drops; calculations are made both on the assumption that the charge is concentrated at the centre and also for the case of a surface distribution. The induction effect of nearby ions is also considered. See also abstract following.

PA-58-1407

M-49. Murphy, A. T. et al.

241 A THEORETICAL ANALYSIS OF THE EFFECTS OF AN ELECTRIC FIELD ON THE CHARGING OF FINE PARTICLES. A.T.Murphy, F.T.Adler and G.W.Penney. Trans Amer. Inst. Elect. Engrs I, Vol. 78, 318-26 (1959) = Commun. and Electronics, No. 44 (Sept., 1959).

Recent measurements of charge imparted to fine particles by unipolar ions in a strong electric field have shown that this charge is appreciably higher than that predicted by previous theoretical analyses. The charge acquired by fine particles is due primarily to ions which strike the particle by virtue of their random heat motion. Previous analyses have assumed that the only field existing was that due to the charge on the particles, thus neglecting any external field which would be present in a corona discharge. Two effects of an external field which influence charging are critically examined: (1) ions or electrons which travel in the direction of the external field toward the particle will acquire energy in addition to their heat energy: their increase in energy will allow these elementary particles to overcome more readily the potential field of the charged particle: this effect is shown to be small for molecular ions at atmospheric pressure except for only the very smallest particles but, for charging by free electrons, which have a much longer mean free path, the effect could cause a large increase in charge: (2) the presence of an external field will alter the density distribution of ions around the charged particle since this field opposes the particle field on one side of the particle and aids it on the other side. The general equation for the ion density distribution was not able to be solved. However, approximate finite difference methods using computing machinery show that this effect is important and may almost completely account for the higher charge found with molecular ion charging.

PA-63-241

M-50. Murphy, P. V. et al.

"Effect of Penetrating Radiation on the Production of Persistent Internal Polarization in Electret-forming Materials," J. Chem. Phys. 38, No. 10, 2400-4 (May 15, 1963).

The electret state was produced in Teflon and carnauba wax by simultaneous action of penetrating radiation and an electric field. Polymethylmethacrylate, polyvinylacetate, polystyrene, polyethylene, and nylon did not form electrets under these conditions. The shapes of isothermal decay curves and thermal depolarization "glow curves" were used to calculate activation energies for the depolarization process in Teflon. The average activation energy as calculated from the "initial rise" of thermodepolarization curves was 0.93 eV. The persistent heterocharge of carnauba wax and of certain polymers may be caused by the orientation of dipolar units composed of a positive molecular ion and a partially solvated electron.

Author

N-1. Nakaya, U., and T. Terada

891. Electrification of Dust Particles Blown by Air Blast. U. Nakaya and T. Terada. *Phil. Mag.* 19. *pp.* 115–123, *Jan.*, 1935.—Measurements were made of the charge of individual dust particles by the microscopic method used by Ladenburg. By the method of Millikan's oil-drop experiment the mode of charging up of an initially uncharged particle of dust in an atmosphere ionised by a point discharge or α-rays was investigated. In the deflection experiments under the microscope particles were blown out of a jet and caused to pass through a space between two electrode plates connected to the terminals of a transformer. The electric field applied was 90 cycles and 2000 *V/cm*. In experiments made to determine the sign the positive and negative particles were separated by a direct electric field. The substances used in the tests were coal dust, resin powder and lycopodium powder. The authors conclude that the charge of dust particles is chiefly produced by a natural friction between them, and consequently the particles blown out by an air blast consist of positive and negative particles mixed together. An important factor in the phenomenon is the abundance of either the total positive or negative charge which is proper to the material of the dust in an algebraic sense.

PA-38-891

N-2. Natanson, G. L.

14976 TOWARDS A THEORY OF THE CHARGING OF NON-MICROSCOPIC AEROSOL PARTICLES AS A RESULT OF THE CAPTURE OF GASEOUS IONS. G.L. Natanson. Zh. tekh. Fiz., Vol. 26, No. 5, 973-86 (May, 1956). In Russian.

The problem is treated in detail. Tables for the ionic flow, equal in stationary conditions to the rate of ion capture, are calculated for the cases of the capture of (a) an oppositely charged, and (b) a similarly charged ion by a charged particle, and (c) the capture of an ion by a neutral particle. The influence of forces of interaction, at distances from the surfaces of the particles less than the mean free path, are calculated. The results are applied to calculate the stationary charge of non-microscopic (i.e. with mass sufficiently greater than that of the ions to allow the motion of the former to be neglected) aerosol particles in a bi-polar ion atmosphere and for an analysis of the process of the electrostatic precipitation of such particles.

PA-63-14976

N-3. Natanson, G. L.

Deposition of aerosol particles from a gas stream flowing around a cylinder. G. L. Natanson. *Doklady Akad. Nauk S.S.S.R.* 112, 666-8(1957). CA 51-16008g

N-4. Natanson, G. L.

Balloelectric phenomena in the spraying of aqueous solutions of organic compounds. G. L. Natanson (L. Ya. Karpov Inst. Phys. Chem., Moscow). *Zhur. Fiz. Khim.* 30, 2662-90(1956); cf. *C.A.* 49, 2149i.

CA 51-10179d

N-5. Natanson, G. L.

Fluctuation theory of the electrization of drops in spraying poorly conducting liquids. G. L. Natanson. *Zhur. Fiz. Khim.* 27, 1106-8(1953);

CA-49-2150b

N-6. Natanson, G. L.

THE PROBLEM OF THE MECHANISM OF BALLO-ELECTRIC PHENOMENA. 23 Oct 61 [10]p. 12 refs.
MCL-1326/1 + 2; AD-265 724.
Order from OTS or SLA $1.10 62-13077

Unedited rough draft trans. of Akademiya Nauk SSSR. Doklady, 1950, v. 73, no. 5, p. 975-978.

DESCRIPTORS: Clouds, Fog, *Drops, *Electrical properties, *Liquids, Atomization, Organic compounds, Inorganic substances, Electrolytes, Ions, Distribution, Electrical conductance.

For aqueous solutions of all substances, at low ion concentrations the sign of the balloelectric effect agrees with the sign of the charge of the capillary-active ion present, and at high ion concentrations it is opposite to the sign of the jump in potential on the surface. The balloelectric effect depends on the application of two factors: the effect of the discontinuity of the ion double layer and the effect of the contact charging. At a low ion concentration, due to the large thickness of the ion diffuse double layer and the low electrical conductivity of the liquid, the first factor predominates and at a high concentration the second factor predominates. For concentrations of purely aqueous solutions of inorganic electrolytes the value of the balloelectric effect is considerably lower than in the presence of capillary-active additives and is virtually independent of the ion jump in potential. This is due, probably, to the fact that the time of relaxation for the ion double layer on the surface is considerably less than for a dipole layer of the absorbed additive.

T7-627

N-7. Natanson, G. L.

THE SYMMETRIC ELECTRIZATION OF DROPS WITH MECHANICAL ATOMIZATION OF LIQUIDS. 15 Nov 61 [24]p. 11 refs. AECL-1324. AD-267 730. Order from OTS or SLA $2.60 62-15160

Unedited rough draft trans. of Zhurnal Fizicheskoi Khimii (USSR) 1951. v. 25. no. 7. p. 779-790.

DESCRIPTORS: *Drops. *Atomization. *Liquids. Density, Boiling, Measurement. Ions. Distribution. *Electrical effects. Mathematical analysis.

We investigate experimentally the electrization of drops for the radius region 0.5 to 2 μ when liquids are atomized which have an ion concentration from 2×10^{-7} to 0.8 mole/liter. The results obtained are discussed from the point of view of the fluctuation mechanism of the phenomenon.

T7-627

N-8. Natanson, G. L.

Natanson, G. L.
THE ELECTRIFICATION OF DROPS DURING ATOMIZATION OF LIQUIDS AS A RESULT OF FLUCTUATIONS IN THE ION DISTRIBUTION. 27 Oct 61 [19]p. 10 refs. AECL-1325. Order from OTS or SLA $1.60 62-13581

Unedited rough draft trans. of Zhurnal Fizicheskoi Khimii (USSR) 1949 [v. 23] no. 3, p. 304-314.

DESCRIPTORS: *Liquids, Atomization, *Drops, Electrical properties, Dielectrics, Ions, Distribution, Probability, Electrolytes, Oils, Fatty acid esters, Ethanols, Amines, Electrical conductance.

A calculation of the magnitude of the fluctuation charges in liquids containing ions is given. The electrification of drops during atomization of liquids in the region of ion concentrations from 1×10^{-11} to 3×10^{-9} mole/liter for drops with radii from 0.5 to 2μ is studied. It is shown that the results obtained agree with the fluctuation theory of the origin of the charges on atomized drops. On the basis of the results obtained a new method of non-electrochemical determination of the ion concentration (the ionic strength) in dielectric liquids is proposed.

T7-269

N-9. Nayyar, N. K., and G. S. Murty

132 THE FLATTENING OF DIELECTRIC LIQUID DROP IN A UNIFORM ELECTRIC FIELD.
N.K.Nayyar and G.S.Murty.
Proc. Nat. Inst. Sci. India A, Vol. 25, No. 6, 373-9 (Nov., 1959).
The equilibrium of a dielectric liquid spherical drop in the presence of uniform external electric field is studied. It is shown that the drop becomes spheroid under the influence of both electric field and surface tension.

PA-64-132

N-10. Neubauer, R. L., and B. Vonnegut

Production of monodisperse liquid particles by electrical atomization. Raymond L. Neubauer and Bernard Vonnegut (General Elec. Co., Schenectady, N.Y.). *J. Colloid Sci.* 8, 551-2(1953); cf. *C.A.* 47, 4167*h*.

CA-48-425c

N-11. Nieboj, H. P.

"Aerosol Spectrometer for Measuring Size, Electrical Charge, and Density of Dust Particles," Kolloid Z., 160, 58 (September 1958).

N-12. Nikliborc, J., and A. Szaynok

8255 INFLUENCE OF F-CENTER CONCENTRATION ON THE ELECTRIFICATION OF THE DUST OF KCl MONOCRYSTALS IRRADIATED WITH β RAYS. J.Nikliborc and A.Szaynok. J. appl. Phys.(USA), Vol. 33, No. 2,613-15 (Feb., 1962).
The electrification of a dust of KCl single crystals irradiated with β-rays is influenced by three factors: absorption of electrons in the crystal, creation of F centres, and secondary emission. The F-centre concentration in crystals irradiated with β-rays for various irradiation times was measured spectrophotometrically. Based on the F-centre model and with the help of statistical calculations, the relationship between the F-centre concentration in the crystal and the surface charge due to F-centres was found.

PA-65-8255

N-13. Nolan, J. J.

"Electrification of Water by Spraying and Splashing," Proc. Roy. Soc. A, 90, 531-543 (1914).

N-14. Nolan, J. J.

2155. ***Breaking of Water Drops by Electric Fields.*** **J. J. Nolan.** (Roy. Irish Acad., Proc. 37. pp. 28-39, May. 1926.)—Tests were applied experimentally to examine conclusions of Wilson and Taylor [Abstract 2331 (1925)] regarding the maximum size of a water drop which can exist in an electric field in the atmosphere. Illuminated uncharged drops of distilled water of different sizes fell at a slow rate between a pair of almost flat plates connected to a Wimshurst machine and having Leyden jars in parallel with it. The drops were observed visually to undergo (1) explosive bursting whatever the size of the drops for values of the field given by $F\sqrt{r} = 3880$, where F is the field intensity in volts/cm. and r the radius of the drop in cm., this agreeing approximately with Wilson and Taylor's results; and (2) a type of disintegration for drops larger than 0·2 cm. radius for field strengths given approximately by $Fr^{5/2} = 600$. Measurements of the charge carried by the broken drops were unsuccessful, but it was found that a sudden increase in the charging of the collecting vessel occurs for results agreeing with those obtained visually on the explosive bursting of drops. The application of the results to the behaviour of raindrops in atmospheric electric fields is considered. PA-29-2155

N-15. Nolan, J. J., and J. Enwright

596. ***Experiments on Large Ions in Air.*** **J. J. Nolan** and **J. Enwright.** (Roy. Irish Acad., Proc. 36. pp. 93-114, July, 1923.)—In this paper are recorded experimental results on the origin, constitution, and behaviour of the large ion in air. The work deals principally with the effect on the large ions of certain substances such as SO_2 and NH_3, with the effect of temperature, with the decay of large ions by combination with small ions, and with the occurrence of multiple charges. The ions dealt with in the experiments are almost exclusively those produced by ordinary Bunsen flames. Ammonia, as also found in the case of the hydrogen flame, cannot act as a starting-point for nucleation. SO_2 and NH_3, if supplied to the flame or subsequently to the flame-gas, cause the ions to grow beyond their normal size and the transition is not gradual but abrupt. When the alteration is produced by the action of the gases on the ions already formed, there is a reduction in the number of ions. With NaCl the number of ions is increased, but whether due to the NaCl supplying extra nuclei or extra ions to the flame, is not clear, although the unsymmetric character of the increase suggests the latter alternative. The idea of the large ion as a rather loose group, originally suggested by de Broglie and adopted to explain certain mobilities observed, is practically compelled by the observations of recombination between large and small ions. The units out of which the ions have been assumed to be built, the various homogeneous groups of ions which in so many cases accompany the final more stable body, reappear when the ion breaks up under the action of high temperature. The further complex stages observed in the case of phosphorus ionisation appear when the ions are affected by the presence of SO_2, NH_3, or NaCl. The large ions present in the atmosphere are possibly in great part produced by the action of ultra-violet light on the moist gas. They carry single electronic charges, and their constant of combination with small ions is between 5 and 10×10^{-6}. PA-27-596

N-16. Nolan, J. J., and H. V. Gill

127. ***Electrification Produced by the Pulverisation of Aqueous Solutions.*** **J. J. Nolan** and **H. V. Gill.** (Phil. Mag. 46. pp. 225-244, Aug., 1923.)—The method of working is as described in a previous paper [see Abstract 2436 (1922)] devoted to the study of the effects obtained with mixtures of distilled water and tap water. In the present work special attention is given to the effects of substances occurring in rain water. It is found that, with the exception of NaCl, such substances do not appreciably diminish the charge produced when a rain-drop is broken in air. Non-electrolytes do not affect the development of charge. A group of substances shown by Lewis to give abnormal adsorption effects includes sodium oleate, methylene blue, congo red, and methyl orange, whose behaviour differs remarkably from that of the ordinary inorganic salts. In the case of methylene blue, 0·5 gramme per 10^6 c.c. of water is sufficient to reduce the positive charge to zero. The negative charge has a sharp maximum at 2·5 g. per 10^6 c.c., and the charge again becomes positive at about 11 g. per 10^6 c.c. It is suggested that certain results on inorganic salts obtained by other observers are due to the presence of impurities. PA-27-127

N-17. Nolan, J. J., and J. G. O'Keeffe

2301. Multiply Charged Large Ions. J. J. Nolan and J. G. O'Keeffe. *Roy. Irish Acad., Proc.* **41.** *pp.* **26-40,** *Jan.*, **1933.**—Continuing previous experiments [see Abstract 2524 (1932)], ion-counting observations made with an Aitken's nuclear counter show that the atmospheric nuclei or nuclei produced by flames can be charged up so as to carry several thousand electronic charges. The mobilities of these bodies do not seem to be affected by their charges. Spray-ions have charges of the order of a hundred electrons. In contradiction to the assertions of Blackwood and of Busse, the existence of definite mobility groups is again demonstrated. PA-36-2301

N-18. Nolan, J. J., and J. G. O'Keeffe

2524. Electric Discharge from Water Drops. J. J. Nolan and J. G. O'Keeffe. *Roy. Irish Acad., Proc.* **40.** *pp.* **86-98,** *Feb.*, **1932.**—An electric field is applied between a hemispherical drop supported on a glass tube and a brass disc, 5 cm. in diameter, having its centre 1 cm. above the drop. For all drops the negative discharge begins at a lower potential difference than the positive, and the negative current always exceeds the positive. When rapid discharge sets in the uniform field F is connected with the radius r of the drop by the formula $F\sqrt{r} = 3{\cdot}6 \times 10^3$. The ions produced in the discharge from a water surface always remain small in pure air; there is no disintegration of the liquid surface of such a kind as to produce nuclei which could become larger ions by picking up the small ones which are present in large quantities.

PA-35-2524

N-19. Nolan, J. J., and J. P. Ryan

1950. Discharge from Raindrops in Intense Fields. J. J. Nolan and J. P. Ryan. *Gerlands Beitr. z. Geophys.* **41. 2. pp. 185–191, 1934.** ***In English.*—It is shown that the discharge from a water-drop, even when it is of such magnitude that the drop is being dissipated as fine spray, is carried only by small ions. No production of condensation-nuclei or large ions occurs. The bearing of this result on C. T. R. Wilson's theory of the thunderstorm is pointed out. [See Abstract 280 (1930).]**

PA-37-1950

N-20. Norgren, C. T.

N63-20216 National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
ONBOARD COLLOIDAL PARTICLE GENERATOR FOR ELECTROSTATIC ENGINES
Carl T. Norgren. Repr. from Progr. Astron. Aeron., v. 9. N.Y., Academic Pr. Presented at the ARS Electric Propulsion Conf., Berkeley, Calif., Mar. 14–16, 1962

A method of colloidal particle generation, based on the expansion and condensation of a material in a nozzle, has been investigated, and is shown to be capable of supplying particles suitable for acceleration in an electrostatic engine. The material is heated is heated in a small vaporizer which supplies a homogeneous vapor to a convergent-divergent two-dimensional nozzle, 15.5 cm long with a rectangular throat 0.273 by 4.48 cm. Flow rate and subsequent particle growth are controlled by regulating temperature and hence, vapor pressure of the material in the vaporizer. The experimental particle-size determination was obtained by visual inspection of photographs taken in an electron microscope. It is demonstrated that particle size can be controlled from 0.005 to 0.05μ and maintain narrow-range distributions suitable for engine application. The colloidal generator was incorporated into a small specialized electrostatic engine. A negative corona discharge was used to charge the colloidal particles and a Pierce accelerator was used to accelerate these particles. A calculated thrust density of 5.80×10^{-3} Newtons/m^2 at a specific impulse of 420 sec was obtained in engine operation.

N63 20216, 20-27

N-21. Norinder, H.

6184. Experiments concerning electrification of snow. H. Norinder and R. Siksna. *Ark. Geofys.*, **2, *Paper* 3, 59–89 (1954) In shorter form in *Tellus*, 5, 260–8 (*Aug.*, 1953).**

Electrification of snow and related phenomena were investigated by measuring: (1) the charge of snow when pouring it from a vessel into a funnel, (2) the charging of an insulated target when letting show hit it as well as the charge of the scattered snow, and (3) the charge in air from blowing snow. Specific, basic phenomena were separated. The charge of larger snow particles collected was dependent on the temperature and on the material of the target. The properties of the surfaces seem to be of importance in these phenomena. Enhanced charges of both polarities were measured in air by ion-counters. It seems that these charges are not due to ions, but may be attributed to very small snow particles suspended in air. A complete insight into the whole problem of electrification of snow might be obtained by a systematic consideration of all these specific phenomena.

PA-57-6184

N-22. Nueckel, H.

"Aerosols in Biological Processes," Zeit. f. Aerosol-Forsch u. Therap. 1-2, 358 (1952-3).

Zu dem Thema, das gleichzeitig das Arbeitsgebiet der ganzen medizinischen und biologischen Aerosolforschung umreißt, nur 3 Gedanken:
Das Aerosol im biologischen Geschehen

1. *als Abgrenzung des wissenschaftlichen und praktischen Arbeitsbereichs des Deutschen Kuratoriums für Aerosolforschung.*
2. *als Faktor von hoher wirtschaftlicher und wissenschaftlicher Bedeutung und*
3. *als Beispiel für den Durchbruch der modernen naturwissenschaftlichen Weltanschauung ins Biologische.*

Author

N-23. Nukiyama, D.

252. Accumulation of Electric Charge on Thunderclouds. D. Nukiyama. *Japanese Journ. of Astron. and Geophys.* **6. 1. *pp.* 63–69, 1928.**

The author applies the results obtained in an earlier paper [see preceding Abstract] to the cases of drops which slowly divide, drops splitting into others of different sizes, rain drops forming in an electrically neutral space, and the subdivision of large drops to explain the different charges acquired by rain drops. These results are applied to the formation of charges in the thundercloud, the effects of induction in increasing the charge, the predominance of negatively charged clouds of this type and the means by which positively charged clouds could result. Lastly, a means of measuring the real volume charge of rain drops is taken.

PA-32-252

N-24. Nukiyama, D., and H. Noto

251. Electrification of Water Drops. D. Nukiyama and H. Noto. *Japanese Journ. of Astron. and Geophys.* **6. 1. *pp.* 41–61, 1928.**

A series of measurements was made with water flowing from a reservoir through an adjustable nozzle into an experimental chamber and falling through an electrical field maintained between two charged plates. Values of the ratio equilibrium potential (V), theoretical potential were plotted against the distance (h) of the nozzle from the upper plate for different potential differences (B) between the charged plates. It was found that V was greater than the calculated value for weak fields, but the ratio decreased as B increased. For B > 20 volts, the ratio is less than unity. When the field is reversed, the ratio is less as B decreases and finally is even negative. The capacity effect of the falling drop, the removal of charge by the drop and a space charge effect are each examined and also the use of different liquids. The authors' results confirm those obtained by Maclean and Goto on the space charges produced by the interaction of water and air and also the waterfall effect, and this effect as well as induction must be considered in the theory of the water dropper.

PA-32-251

N-25. Nutting, A.

"Electrostatic Air Filters," Southern Power and Industry 63, No. 2, 115-118 (February 1945).

O-1. O'Connor, T. C.

960. SOME CHARACTERISTICS OF CONDENSATION NUCLEI STORED IN A LARGE VESSEL. T.C.O'Connor. Geofis. pura appl., Vol. 31, No. 2, 107-14 (1955).

The coagulation coefficient, size and charge distribution of condensation nuclei from room air when stored in a 4000 litre rubber balloon gasometer were studied. The results indicate that the acquisition of water vapour contributes to the growth of stored nuclei. A preliminary trial was made to see if Junge's approximate rule that the number of particles in an aerosol varies inversely as the third power of their radius, also holds for Aitken nuclei. Further confirmation of the relationship between the percentage of stored nuclei electrically charged and their average radius was obtained. The measurements were carried out by means of the Pollak—Murphy improved version of the photoelectric nucleus counter. A statistical analysis based on over a thousand comparisons of two identical models shows that the agreement of individual readings is better than 10% of nucleus concentration in 80% of all cases. Excessive differences have now been eliminated.

PA-60-960

O-2. O'Konski, C. T., and R. L. Gunther

Verification of the free-energy equation for electrically polarized droplets. C. T. O'Konski and R. L. Gunther (Univ. of California, Berkeley). *J. Colloid Sci.* 10, 563-70(1955); cf. *C.A.* 48, 3103a.

CA-50-4585f

O-3. O'Konski, C. T., and H. C. Thacher

81

7404. The distortion of aerosol droplets by an electric field. C. T. O'Konski and H. C. Thacher, Jr. *J. phys. Chem.*, 57, 955-8 (*Dec.*, 1953).

An equation has been derived for the distortion of a liquid aerosol droplet under the influence of a parallel electric field. The equation, valid for static fields in insulating media, can be reduced to a simple form for many cases of interest. Numerical values of the distortion are computed for water and dioctyl phthalate droplets. The droplet becomes longer in the direction of the field, whether its dielectric constant is greater or less than that of the surrounding medium, because of the decrease in total electrostatic free energy of the system which accompanies this distortion in both cases. This effect is of interest in connection with size studies of aerosol droplets. It leads to predictions of an electric birefringence and of effects involving the scattering of electromagnetic radiation by liquid aerosol systems. A new method is proposed for studies of size distribution in aerosol systems containing large liquid droplets. It would employ the above effect to induce, by means of a periodic electric field, the natural resonant vibrations of the liquid droplets, which could be observed by the resulting modulation of the birefringence or of the light scattered by the aerosol. The distortion is also of interest for the study of dynamic surface tension by means of potentially very accurate measurements of the resonant frequencies of airborne or hanging drops.

PA-57-7404

O-4. Osamu, I. G.

Atomization of liquid by high voltage. I. Gohei Osamu (Electrostatic Painting Machine Co. Ltd. Osaka). *J. Electrochem. Soc. Japan* 24, 229-33(1956).

CA-51-2305c

O-5. Ouang, T. T.

Electrification of particles suspended in a gas by ions produced by X-rays or radioactive substances. Ouang, T.-T. *Ann. Phys., Paris*, 16, 47-144 (*July-Sept.*, 1941) *In French.*—The equilibrium between large and small ions in a gas, the large ions being produced on smoke particles and the small ions by means of Po or X-rays, has been investigated. When equilibrium is established between the two types in the presence of neutral particles, a definite fraction of the neutral particles is converted into large ions of each sign. This fraction depends on the size of the particles, but is independent of the concentration of small ions if this is large. The number of large negative ions is always greater than the number of large positive ones, however large the particles may be, and the number of large ions is independent of the presence in the gas of particles previously charged. An application of the theory of Langevin gives the coefficient of formation of large ions. The different results obtained by various workers on large ions in the atmosphere can be explained on the basis of the theory. There appears to be a favoured radius for ions produced on smoke particles or in the atmosphere.

PA-49-2332

P-1. Pannetier, P.

10666 STUDY OF THE EMISSION OF ELECTRICALLY CHARGED PARTICLES PRODUCED BY THE PULVERIZATION OF ELECTROLYTIC SOLUTIONS. P.Pannetier. Ann. Phys. (Paris), Ser. 3, Vol. 5, No. 1-2, 225-63 (Jan.-Feb., 1960). In French.

The pulverization of a water surface by bubbling devices produces droplets negatively charged, and this appears to be an inherent effect and not due to secondary causes it still occurs when the surface is exposed to either a positive or a negative field. The negative charge is reduced in the case of electrolytes, and decreases as the concentration increases; it is due to the ions and not to the undissociated molecules. Data are given for HCl, NaCl, HNO_3, $LiNO_3$, KNO_3, $CsNO_3$, $Ba(NO_3)_2$, $AgNO_3$, LiF, LiI, LiOH, CH_3COOH and phenol. Electrolytes of the same conductivity have similar effects, and it is found that the anions and cations do not act by the signs of their charges but by their mobilities. Phenol and aqueous solutions of phenol give negative charges comparable with those of water, whereas the presence of CO_2 diminishes the negative charge. In addition to the effect of rupture of the surface double layer, a part of the charge is thought to be due to the rupture of the links between the water molecules resulting in the liberation of electrons. The influence of concentration and ionic mobility on the phenomena are discussed. There are 34 references.

PA-63-10666

P-2. Passoth, G.

8158. ON THE ATTEMPT TO DETERMINE EXPERIMENTALLY THE POTENTIAL DIFFERENCE AT THE SURFACE OF WATER. G.Passoth. Z.Elektrochem, Vol. 60, No. 4, 420-3 (1956). In German.

On the assumption that within the surface layer the dielectric constant is smaller than in the interior of the water the potential difference at the surface is assessed at 0.2 to 0.3 volt. It is shown experimentally that the value determined by Chalmers and Pasquill (Phil. Mag., Vol. 23, 88, 1937) must be explained by contamination of the water surface by organic impurities.

PA-59-8158

P-3. Patterson, H. S., and R. Whytlaw-Gray

"On the Densities of Particles in Smokes," Roy. Soc. Proc. A, 113, 302 (December 1, 1926).

P-4. Patterson, H. S. et al.

376. Structure and Electrification of Smoke Particles. H. S. Patterson, R. Whytlaw-Gray and W. Cawood. *Roy. Soc., Proc.* 124. *pp.* 522-532, *July* 1, 1929.

The experiments have brought to light no marked difference in the coagulation rates of comparable smokes which differ greatly in electrical character. The difference between the rate of coagulation of comparable smokes of MgO and ammonium chloride indicate that electrification exercises little, if any, effect. Moreover, the authors have as yet detected no appreciable difference in the coagulation of ammonium chloride smokes of the same weight concentration, dispersed either normally or in the presence of X-rays.

PA-33-376

P-5. Patterson, H. S. et al.

375. Coagulation in Smokes, H. S. Patterson, R. Whytlaw-Gray and W. Cawood. *Roy. Soc., Proc.* 124. *pp.* 502-522, *July* 1, 1929.

The authors carry out further experiments on smokes and study the possible influence of the degree of heterogeneity and of electrification, as well as the effect of size on the rate of coagulation. Before embarking on this programme, the process of counting was scrutinised, errors eliminated and the method improved.

PA-33-375

P-6. Paul, W.; H. P. Reinhard, V. von Zan

"Electrostatic Particle Containment," Zeitschrift for Physik 152, 143 (1958).

P-7. Pauthenier, M.

7945. Singularities of the speed of precipitation of submicronic particles in ionizing electric fields. M. PAUTHENIER. *C.R. Acad. Sci.* [*Paris*] 240, *No.* 18, 1761-3 (*May* 2, 1955) In French.

A continuation of previous work [see Abstr. 6121 (1955)]. The charge acquired by a particle ($\leq 10^{-7}$ cm) as a function of the time spent in the field is calculated and indicates a logarithmic growth of charge with time. Further considerations suggest that there is a minimum speed of precipitation for submicronic particles.

PA-58-7945

P-8. Pauthenier, M.

6121. Theory of the speed of precipitation of submicron particles in ionized electric fields. M. PAUTHENIER. *C.R. Acad. Sci.* [*Paris*] 240, *No.* 15, 1610-11 (*April* 13, 1955) In French.

It is stated that thermal agitation of ions is the chief factor contributing to the charge on particles of submicron dimensions. Boltzmann's distribution law is used to derive an equation giving the number of ions captured by these particles as a function of time.

PA-58-6121

P-9. Pauthenier, M.

4941. Electrical coalescence of fog and clouds. M. PAUTHENIER. *Centen. Proc. Roy. Met. Soc.* (1950) 60-1.

A summary of work shows that to precipitate a normal fog by seeding with neutral water droplets of radius 10^{-3} cm, 660 kg of water/10^4 m^2 must be used. For charged droplets 6 kg of water/10^4 m^2 is required. Such an application is possible because of the very large disruptive electrical field of small droplets, but otherwise there would be a discharge between the charged spherical particle and the neutral fog or cloud droplet with the very strong charges used. For a thick fog account must be taken of the increase of the radius of the charged droplet as it falls through the fog.

PA-54-4941

P-10. Pauthenier, M.

"Some Recent Results in the Field of High Voltage Precipitation of Particles," Bull. Soc. Fran. Elec. 1, 577-81 (1941).

P-11. Pauthenier, M.

2298. Production of H.V. by Currents of Electrified Particles. M. Pauthenier. *Soc. Franç. Élect., Bull.* **9.** *pp.* **638–646,** *Aug.,* **1939.** *In French.*—**An outline of recent progress. A brief description is given of generators which have been constructed and others in process of construction which employ additional ionisers in the current stream. It is expected to obtain 2 mA at 2 MV from a single pole of one such generator.**

Abstract No. 2298 in Science Abstracts, Section B, 1939

P-12. Pauthenier, M., and L. Agostini

5235. Law of Charge of a Spherical Particle in an Ionised Field. M. Pauthenier and L. Agostini. *Comptes Rendus,* **199.** *pp.* **705–706,** *Oct.* **16, 1934.**—**When a small sphere falls for a time t in a constant electric field, the fraction of the charge which could be gained by the ball [see Abstract 4463 (1932)] is $\lambda = t/(t + \tau)$, where $\tau = 1/\pi\kappa\rho$, κ is the mobility of the ions and ρ the density of the space charge. The field is produced by a wire carrying a negative potential stretched along the centre of an earthed cylinder of 40 cm. dia. A steel ball falls through a tube of insulating material placed at a constant distance from the centre. The law is found to be correct to within 3 % when the velocity of the sphere is half that of the ions.**

PA-37-5235

P-13. Pauthenier, M., and R. Cochet

15209 **THE TWOFOLD PHYSICAL ASPECT OF THE INFLUENCE OF DUST DEPOSIT ON THE ELECTRICAL PURIFICATION OF AEROSOLS. M.Pauthenier and R.Cochet. C.R. Acad. Sci. (France), Vol. 252, No. 21, 3204-6 (May 24, 1961). In French.**

Consideration of a vertical cylindrical precipitation unit by means of a previously developed formula (Cochet and Reffay, Abstr. 7152 of 1955) indicates how the efficiency of an electro-filter depends on both the amount of dust deposited and the consequent counter-electrical field developed.

PA-64-15209

P-14. Pauthenier, M., and R. Cochet

7365. **Development of a charged water droplet in a cloud above freezing level.** M. PAUTHENIER AND R. COCHET. *Rev. gén. Elect.,* **62,** 255–62 (*May,* 1953) *In French.*

A theoretical examination is given of the coefficient of capture by an electrified water droplet. The rate of its growth and the min. charge required by the droplet are determined. The effects are examined which the results obtained may have on the problem of natural precipitation as well as the artificial seeding process of clouds.

PA-56-7365

P-15. Pauthenier, M. et al.

3229. GENERAL PROBLEM OF THE CHARGE ACQUIRED BY A SPHERICAL PARTICLE IN AN ELECTRIC FIELD WITH NEGATIVE AND POSITIVE IONS. M.Pauthenier, R.Cochet and J.Dupuy. C.R. Acad.Sci. (Paris), Vol. 243, No. 21, 1606-8 (Nov. 19, 1956). In French.

Mathematical derivation of the formulae and investigation of the electrostatic conditions, with generalized assumptions, in a field containing positive and negative ions. A short reference to industrial applications (electric filters and electric precipitation) is made.

PA-60-3229

P-16. Pauthenier, M., and R. Guillien

4463. Direct Electrometer Measurement of the Limiting Charge of a Conducting Sphere in an Ionised Electric Field. M. Pauthenier and R. Guillien. *Comptes Rendus,* **195.** *pp.* **115–116,** *July* **11, 1932.**—**It is found that, when spheres of steel of 0·5 to 3·5 mm. radius are allowed to fall freely in an ionised cylindrical electric field of 30 cm. dia. and 2 m. height, and their charge is given up to a string electrometer of 5 cm. capacity, the spheres have received a maximum charge. This charge [see Abstract 1324 (1932)] is given by the equation $Q_0 = 3E_0a^2$, where E_0 is the field and a the radius of the sphere, and is verified experimentally.**

PA-35-4463

P-17. Pauthenier, M., and L. Loutfoullah

1544. The electric scavenging of clouds. M. PAUTHENIER AND N. LOUTFOULLAH. *C.R. Acad. Sci., Paris,* 231, 953-6 (*Nov.* 6, 1950) *In French.*

The possibility of a large charged water drop attracting smaller uncharged drops in a cloud is investigated. It is shown that particles will be attracted which are not directly in the path of the falling sphere and so the effective radius for collision is increased. Numerical calculations show that the release of charged water drops above a cloud or fog would be a very uneconomic method of precipitating the water drops.

PA-54-1544

P-18. Pauthenier, M., and C. Martin

1360. Limiting Electric Charge of Very Fine Particles. M. Pauthenier and C. Martin. *Comptes Rendus,* **204.** *pp.* **239–240,** *Jan.* **25, 1937.**—**The theory already shown experimentally to be valid for particles of sizes 20–360μ and 1—7 mm. is now shown to be equally valid for particles 2—20μ. [See Abstract 4463 (1932).]**

PA-40-1360

P-19. Pauthenier, M., and M. Moreau-Hanot

413. Quenching of Corona Discharge by Suspended Particles. M. Pauthenier and Marguerite Moreau-Hanot. *Comptes Rendus,* **199.** *pp.* **1193–1194,** *Nov.* **26, 1934.**—**In a previous paper [see Abstract 3862 (1934)] the theory of the influence of an atmosphere of suspended particles on the corona discharge from a wire surrounded by a cylinder, has been developed. The present work is an attempt to confirm the results experimentally. So long as the drop in corona current is less than 30 %, theory and experiment appear to be in good agreement. The theory developed explains the progressive quenching of the corona discharge as the concentration of dust in the surrounding atmosphere is increased ; the space-charge opposing more and more the emission of new charges from the central electrode.**

PA-38-413

P-20. Pauthenier, M., and M. Moreau-Hanot

3862. Electrified Space Containing Material Particles. M. Pauthenier and Marguerite Moreau-Hanot. *Comptes Rendus*, **199.** *pp.* **189–190,** *July* **16, 1934.**—Previous calculations of the electric field in a cylindrical ionisation chamber, have been modified by the assumption of the presence of a stream of air containing dust particles. An additional term, corresponding to the space-charge due to the particles, is introduced into the Poisson equation. It is shown that the passage of a stream of air containing material particles results in a drop in the current Δi; an increase of the potential on the electrodes ΔV_m is required to restore the original current. Δi and ΔV_m are calculable. If potential distribution curves are drawn for the cases with and without dust, it can be shown that, in spite of the decrease of the current, the field near the wall increases.

PA-37-3862

P-21. Pauthenier, M., and M. Moreau-Hanot

1636. Spherical Particles in an Ionised Field. M. Pauthenier and (Mme.) M. Moreau-Hanot. *J. de Physique et le Radium*, **3.** *pp.* **590–613,** *Dec.*, **1932.**—The systematic study of an air-filter, a metallic tube with a central wire at a high potential, with special reference to the maximum charge which can be carried by conducting or non-conducting particles across the tube. Among the particles the behaviour of which was examined were spheres of Rose's fusible alloy projected by compressed air from an orifice in a tube, and measuring from a few microns to 100 in diameter. They followed the appropriate path until they were embedded in a film of moist gelatin. The charge acquired by a conducting particle is $3E_0 \times a^2$, where E_0 is the field and a is the diameter of the particle. For insulating particles, 3 must be replaced by a more complex factor.

PA-36-1636

P-22. Pauthenier, M., et al.

4464. Charge on Small Dielectric Spheres in an Ionised Electrical Field. M. Pauthenier, (Mme.) Moreau-Hanot and R. Guillien. *Comptes Rendus*, **195.** *pp.* **213–215,** *July* **18, 1932.**—The calculation of the charge now submitted for small dielectric spheres is analogous to that already made for conducting spheres [see Abstract **1324 (1932)**], wherein it suffices to replace the induced charges upon the conducting particle by the polarisation charges of the dielectric. For particles of radius beyond a few microns, the limiting charge Q_0 is expressed by the relation $Q_0 = pE_0a^2$, where $p = 1 + 2(\epsilon - 1)/(\epsilon + 1)$, ϵ being the specific inductive capacity, E the intensity of the ionised field and a the particle radius. This result has been verified by two different methods, *viz.*, an electrometric process adapted to spheres of radii around 1 mm., and one limited to small spheres of radii 10 to 200 μ based upon trajectories. The particles investigated were of gum lac, ebonite, paraffin and naphthalene.

PA-35-4464

P-23. Peace, A. G.

3427. The electrostatic ignitibility and electrification of finely powdered Hexamine. A. G. Peace. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 94–S 96 (1953).

It is shown that finely divided dry Hexamine powder when dispersed in a dust cloud can be ignited by electric sparks of energy less than 0·005 J and that certain previously established principles of spark ignition apply also to this substance. No ignition of heaped powder by similar means could be produced. The powder is shown to be readily electrified in various mechanical operations similar to those used in manufacturing processes, charges of the order of 10^{-9} C/g being produced.

PA-57-3427

P-24. Peek, F. W. Jr.

Dielectric Phenomena in High Voltage Engineering, 2nd Ed., McGraw-Hill Book Co. (1920).

P-25. Penney, G. W.

"A New Electrostatic Precipitator," Elec. Eng. 56, 159-163 (January 1937).

P-26. Penney, G. W., and R. D. Lynch

16913* Measurements of Charge Imparted to Fine Particles by a Corona Discharge. Gaylord W. Penney and Robert D. Lynch. *Communication and Electronics*, 1957, July, p. 294 + 6 pages.

Studies are applied to electrostatic precipitation.

BMI 6-16913

P-27. Penning, F. M.

"Electrical Discharge in Gases," The Macmillan Company, New York, 75 pp. (1957).

P-28. Penning, F. M.

"Concerning the Probability of Ionization on Collisions Between Electrons and Atoms," Physica 6, 290-7 (1926).

P-29. Penning, F. M., and C. F. Veenemans

"On the Collision Between Positive Ions and Atoms," Zeit. fur Physik 62, 746-763 (1930).

P-30. Pennsylvania State Univ.

"Electrical Precipitation--1959-1960," Paper presented at the Engineering Seminar on Electrical Precipitation June 15-19, 1959 and June 12-17, 1960, Engineering Proceedings P-37.

P-31. Perucca, E.

998. Electrification by Friction between Solids and Gases. E. Perucca. *ZS. f. Phys.* **46. 9–10.** *pp.* **747–752, 1928.**

A previous paper [see Abstract 143 (1926)] gave an account of a series of researches the results of which were interpreted as an instance of electrification by friction between solids and gases. Güntherschulze's criticisms, and especially his objection that the observed phenomenon is due to a simple voltaic effect caused by minute drops of mercury, induced the author to repeat his investigations with an apparatus differing only slightly from that previously used, but so modified as to exclude the formation of such drops. The result of these renewed experiments is, briefly, a confirmation of his previous conclusions. An illustration of the modified apparatus is given. PA-31-998

P-32. Perucca, E.

564. Contact Theory of Frictional Electricity. E. Perucca. *Zeits. f. Phys.* **51. 3–4.** *pp.* **268-278, 1928.**

An investigation was carried out which maintained the view of the existence of the Volta effect of the first kind, *i.e.*, the existence of an electrostatic field in the dielectric around two insulators brought into contact. The favourable outcome of the research applies to the contact between a solid and a liquid insulator; but there is no ground for supposing that there should be any substantial difference in behaviour in the case of two solids in contact. The result obtained affords an argument in favour of the contact theory of frictional electricity. PA-32-564

P-33. Perucca, E.

2161. Triboelectric Effect between Solids and Gases. E. Perucca. *Comptes Rendus,* **186.** *pp.* **850–853,** *March* **26, 1928.**

Describes a case of frictional electrification of a solid by a gas in a high vacuum. The gas is mercury vapour from a drop of mercury kept at about 100° C. The electrification is measured by an iron collector in contact with an electrometer. The collector can be heated electrically to about 200° C. A comparison made between this electrification and electrification produced by small mercury drops in the same vessel and with the same collector shows that the action of a jet of vapour is not a Volta effect, but a true effect of frictional electrification. PA-31-2161

P-34. Perucca, E.

143. *Electrification by Friction between Solid Bodies and Gases.* **E. Perucca.** (Zeits. f. Physik, 34. 2-3. pp. 120–130, 1925.)—Experiments carried out with a Volmer mercury-vapour pump, a stream of mercury-vapour being made to impinge on a metallic wall. The electrification resulting from the contact of liquid mercury and metal is reduced to the simple Volta-effect, and therefore negligible. Wetting of the metal by the mercury was avoided. The metals employed were iron, nickel and platinum. A discussion, partly mathematical, of the observed results leads to the conclusion that the existence of a new form of electrification has been established, though the phenomena cannot be considered as fully elucidated. An illustration of the apparatus is given. PA-29-143

P-35. Perucca, E.

349. *A New Case of Tribo-electricity.* **E. Perucca.** (Phys. Math. Soc. Japan, Proc. 7. pp. 112–113, June, 1925. In English.)—This is a somewhat elaborated account of work described in the preceding Abstract. The apparatus used is here more fully described by means of a diagram, and the following conclusions are drawn. A few indications of the fact that the metal oxides must be considered strongly electro-negative are found; it is observed that a newly nickeled surface acts in a sensibly different manner from the same surface some days old. But even in this case characteristic uncertainties and difficulties of seeking a voltaic or a tribo-electric series are met with. It is not found possible to arrange the metals in a series analogous to the voltaic one. There is not a decisive experiment showing the identity of electrification described by Doi and friction-electricity, but all the observed facts may be interpreted as tribo-electric phenomena (including Strömungsstrom). It is therefore considered that any other hypothesis about the origin of this electrification is superfluous. PA-29-349

P-36. Perucca, E.

348. *A New Case of Contact Electricity.* E. Perucca. (Accad. Sci. Torino, Atti, 60. 4 and 5. pp. 88-92, 1924-1925.)—An interesting method of electrification has recently been noted by U. Doi when introducing a hot metallic ball into an insulating liquid. If the temperature of the ball is high enough to produce a violent ebullition of the liquid, the metal and liquid assume a separating voltage, the potential of the ball surpassing 1000 volts in such a case. Doi attributes the phenomenon to the separation of the charge constituting the double layer at the liquid-metal surface during the violent boiling of the liquid. In the present paper the author endeavours to show that this result can be considered as another example of contact electricity. He, however, concludes that he has not been able to show definitely that this is the case, but that all the facts observed can be easily interpreted as contact-electricity phenomena. [See also Abstract 1465 (1920).]

PA-29-348

P-37. Peterson, John W.

"Contact Charging Between a Borosilicate Glass and Nickel," J. App. Phys. 25, No. 4, 501 (1954).

An investigation has been made of the charging of fused quartz and borosilicate glass spheres rolling on a clean nickel surface. The results indicate that the process of acquiring charge depends only upon the nature and surface condition of the materials in contact and is independent of the pressure of an atmosphere of dry N_2. The total charge, however, is limited by gaseous discharge to the metal and therefore does depend upon the pressure. Such gaseous discharge has been verified by the observation of individual discharge pulses. The rate of acquiring charge and maximum charge in vacuum has been found to depend upon rolling speed, both reaching a maximum at an intermediate speed, and to decrease with increasing surface conductivity. Since both fused quartz and borosilicate glass charge negatively in contact with clean nickel, it is inferred that both have higher effective work functions than nickel. The surface conductivity of borosilicate glass has been found to be three of four orders of magnitude higher than that of quartz. Therefore, since the charging of the two materials is of the same order of magnitude, the effective work function of the glass appears to be considerably higher than that of fused quartz.

Author

P-38. Peterson, J. W.

"Contact Charging Between Nonconductors and Metal," J. App. Phys. 25, No. 7, 907 (1954).

The charging of borosilicate glass spheres rolling on clean nickel has been studied under controlled conditions of cleanliness, humidity, and gas pressure. Strong evidence indicates the process of charge transfer to be a type of contact electrification akin to that operating between two metals. The observed charging is, however, influenced by other factors. The amount of charge acquired increases with surface areas in contact and hence with distance rolled until other factors intervene. The rate of charging depends on rolling speed and surface conductivity of the borosilicate glass, while the maximum equilibrium charge depends on the pressure of the ambient gas. The gas pressure effect is shown to be caused by electrical discharge of the highly charged sections of the borosilicate glass to the metal, as suggested by E. W. B. Gill, and this causes a minimum equilibrium charge to occur about 1 mm air pressure, as observed by D. E. Debeau. The effect of transverse electrical fields reported by E. W. B. Gill and G. F. Alfrey is negligible for low surface conductivity but becomes important at higher surface conductivity, in particular above 40 percent relative humidity at 20°C.

Author

P-39. Phillips, B. B., and R. Gunn

2338* Measurements of the Electrification of Spheres by Moving Ionized Air. B. B. Phillips and Ross Gunn. *Journal of Meteorology*, v. 11, Oct. 1954, p. 348-351.

Experimental measurements permits determination of the functional dependence of the charge magnitude and rate of accumulation upon the ventilation velocity. Graphs, diagram. 4 ref.

BMI 4-2358

P-40. Phillips, B. B., and G. D. Kinzer

3012. MEASUREMENTS OF THE SIZE AND ELECTRIFICATION OF DROPLETS IN CUMULIFORM CLOUDS.
B.B.Phillips and G.D.Kinzer.
J. Meteorol., Vol. 15, No. 4, 369-74 (Aug., 1958).

The size and the free electric charge of more than 6000 individual natural cloud droplets were measured. The measurements were made in stratocumulus clouds and in thunderstorm-associated clouds. Stratocumulus clouds with fair-weather electric fields were found to have approximate Gaussian-charge distributions symmetric about zero charge. The magnitude and distribution of charge observed on these non-storm clouds approach values described recently by Gunn (1956) in his theory of aerosol electrification by the diffusion of environmental light ions. Thundercloud droplets were highly electrified and within given cloud volumes the droplets were charged entirely positive, entirely negative, or fractionally positive and negative.

PA-62-3012

P-41. Pich, J.

Theory of electrostatic scattering of monodisperse aerosols. J. Pich (Akad. Wiss., Prague). *Staub* 22, 15-17 (1962).

CA 56-13573h

P-42. Pierce, E. T.

8079. EFFECTS OF HIGH ELECTRIC FIELDS ON DIELECTRIC LIQUIDS. E.T.Pierce.
J. appl. Phys., Vol. 30, No. 3, 445-6 (March, 1959).

The drop size and repetition frequency in spray from a negatively charged nozzle, towards a positive ring electrode, are determined by the relaxation time (permittivity/conductivity) of the liquid and by the amplitude of the stress applied. Electrophoretic effects are believed to occur in liquids containing ionic impurities, whereas dielectrophoretic effects are dominant in highly pure liquids (Abstr. 282/1959).

PA-61-8079

P-43. Pike, E. W.

"The Charging of Aerosols in a Corona Discharge," Phys. Rev. 83, 194 (1951).

The Charging of Aerosols in a Corona Discharge. EUGENE W. PIKE, *Raytheon Manufacturing Company.*—Quantitative calculation of the rates at which aerosol particles would be expected to gain charge, in passing through a corona discharge in air, as a result of the various expected processes, indicates that the present conventional explanations cannot account for the observed facts. Specifically, neither ion diffusion nor the induced dipole in the aerosol mote can account for the observed charges on motes smaller than 10 microns. It seems probable, from present knowledge, that photoelectric effect is responsible for the charging of particles in the positive corona, and that electron diffusion may dominate in the negative corona. Some evidence is found for an expected limitation, by cold emission, on the negative charge a mote can carry.

Author

P-44. Pluvinage, P.

"Study of the Formation of the Frost as a Function of the Electric Charge of Frosted Clouds," Bull. du GRA 3, 49 (1946).

P-45. Pollak, L. W., and A. L. Metnieks

N62-14542 Dublin Inst. for Advanced Studies. School of Cosmic Physics (Ireland).
THE APPROACH TO CHARGE EQUILIBRIUM IN A STORED AEROSOL DURING AGING. Technical (Scientific) Note No. 16.
L. W. Pollak and A. L. Metnieks. 14 p. Repr. from Geofis. Pura e Appl. (Milan), v. 51, 1962/1. p. 225-236. 13 refs. Summaries in English and German.
(Contract AF 61(052)-26)
(AFCRL-62-819)

The approach during natural aging to charge equilibrium of an aerosol produced and stored in a polyester (Mylar) balloon gasometer with metallized internal surface and 4200 liters content is studied. The number of charged condensation nuclei at any instant is related to the number of charged nuclei present at the same moment in electrical equilibrium produced by alpha-irradiation of the aerosol. It is shown that a stored aerosol consisting of small nuclei of moderate concentration occurs not later than 15 minutes after their birth in electrical equilibrium. With increasing size and concentration of the nuclei it takes longer and longer until the stored aerosol attains charge equilibrium. Stored large nuclei appear not to reach exact charge equilibrium even after several days.

The reasons for replacing the rubber balloon gasometer, used previously, by the Mylar balloon for this investigation are given. In connection with the ionizing radiation required for producing charge equilibrium, the generation of condensation nuclei by alpha-radiation in stagnant and moving nucleus-free air has been investigated. It has been found that no condensation nuclei are being produced in filtered (nucleus-free) air for air-flows of between 0.1 and 20 liters/min in a tube of 4.2 cm diameter by the alpha-rays of Polonium 210 of about 125 μc.

N 62-14542,12-21

P-46. Pollermann, M.

5566. Drop formation on ions in the Wilson cloud-chamber. M. POLLERMANN. *Ann. Phys., Lpz.* (*Folge 6*) 5 (*No.* 6-8) 329-48 (1950) *In German.*

The diffusion of a thin column of ionization (from a timed X-ray discharge) in an electrostatic field, applied for varying intervals during the increase of supersaturation at expansion, is used to study the variation of size of the embryo stable droplet as a function of supersaturation. The results are in agreement with the treatment of Volmer.

PA-53-5566

P-47. Power, A. D.

132. *Recombination of the Natural Ions in Air; Weak Atmospheric Ionisation.* A. D. Power. (Frank. Inst., J. 196. pp. 327-352, Sept., 1923.)—The coefficient of recombination of ions in air was determined for "natural" ionisation as opposed to the strong "artificial" ionisation usually used. McClung's method was replaced by a new method requiring the measurement of the growth with time of the number of ions per cm.^{3}. The diffusion correction is based upon a solution obtained for $\partial n/\partial t = D(\partial^2 x/\partial t^2) - \beta n + q$. Results substantiate von Schweidler, that for natural ionisation it is more appropriate to use a βn than an αn^2 term; this is here extended to confined air under α- and β-rays. The value of β is on the average 6×10^{-3}, even when the dust content is very low. Its use cannot, therefore, depend upon the presence of dust: but in any event a very small quantity of dust would explain it. Under natural ionisation the distribution of ions appears to be non-uniform, confined to non-overlapping columns. For low potentials, the capacity of an air-condenser with plates, say, 20 cm. apart may be increased by the factor 2·7 by natural ionisation. If the plates of a closed condenser be momentarily earthed they will in the final state be at zero potential, no matter what the original distribution of ions may be.

PA-27-132

P-48. Power, G.

7934. A general mathematical treatment applicable to certain electrode systems. G. POWER. *Brit. J. appl. Phys.*, 6, *No.* 7, 245-7 (*July*, 1955).

Some general formulae are obtained concerning the perturbation effects on certain two-dimensional electric fields of dielectric cylinders, assumed homogeneous and isotropic, with various boundary shapes. By taking particular values for the dielectric constants, these formulae lead to results of interest for particular electrode systems.

PA-58-7934

P-49. Prati, A.

530. *Charge on Non-Conducting Plates by Rubbing.* A. Prati. (Accad. Lincei, Atti. 31. ii. pp. 478-481, Nov. 19, 1922.)—The arrangement adopted by Cardini [see Abs. 2125 (1922)] when investigating the electric charge by means of the phenomena of ionisation and, reciprocally, that phenomena by means of the charge, has suggested the experiments here described. A qualitative and quantitative study is now made, with a ballistic galvanometer, of the charge which accumulates on a non-conducting plate by stroking one face, say with wool, and holding the other in contact, or not, with an armature in communication with earth. The substances experimented with include sulphur, ebonite and sealing-wax. The results given show that at first the quantity of electricity increases almost proportionately to the number of strokes, then a true state of electrical saturation of the plates is rather rapidly approached. These results are in accord with those obtained by Cardini and also with those of Morris Owen.

PA-26-530

P-50. Pudovkina, I. B., and A. P. Katsyka

Pudovkina, I. B. and Katsyka, A. P.
MEASURING ELECTRICAL CHARGES IN ARTIFICIAL FOGS AND NATURAL CLOUDS (Izmereniya Elektricheskikh Zaryadov Iskusstvennykh Tumanov i Yestestvennykh Oblakov) 9 Sep 60, 13p. 6 refs.
JPRS: 5356.
Order from OTS $0.50

Trans. of °Akademiya Nauk SSSR. Izvestiya. Seriya Geofizicheskaya, 1960, no. 5, p. 707-713.

Two independent methods of measuring the total charge on cloud particles give results which agree satisfactorily. The flow trap method is distinguished by its extreme simplicity and rapidity. The method can be employed with an error of 40-50%, if the diameters of the particles are within the range 5-50 mu. It is then possible to get an idea of the sign and order of magnitude of the total charge on a cloud. As a rule, stratocumulus and artificial condensation fogs have a negative total charge. The average absolute charges on a particle, determined by the instruments, are greater than those calculated theoretically for a diffusion mechanism of charging. The latter, evidently, plays a part in the initial charging but the later increase in the charge on the particle may be due to coagulation processes.

T4-562

Q-1. Quinton, A.

3431. Safety measures in operating theatres and the use of a radioactive thallium source to dissipate static electricity. A. QUINTON. *Brit. J. appl. Phys. Suppl. No. 2 [Static electrification]* S 92-S 93 (1953).

Precautionary measures to minimize the risk of explosion due to the ignition of anaesthetic gas mixtures are described briefly. Special attention is given to the elimination of charges of static electricity, including the use of an apparatus incorporating a radiothallium source. The apparatus causes a stream of air to pass over the radiothallium and the ionized air so produced is effective in removing electrostatic charges at distances up to 6 ft. The radiation risk to theatre personnel is negligible. Some interesting measurements concerned with the safety of the use of plastics and the wearing of nylon stockings are given.

PA 57-3431

68

R-1. Rajagopal, E. S.

1493 PARTICLE SIZE DISTRIBUTIONS IN ULTRASONIC EMULSIFICATION. E.S.Rajagopal.
Proc. Indian Acad. Sci. A, Vol. 40, No. 6, 333-9 (June, 1959).
The sizes were studied and were shown to be of the same order (~ 1μ) as those obtained in colloid mills. The effect of continued irradiation to increase the mean size of the particles and to broaden the size distribution. The results are quantitatively analysed in terms of the lognormal particle size distribution.

PA 64-1493

R-2. Ralston, O. C.

Electrostatic Separation of Mixed Granular Solids, Elsevier, 261 pp. (1960).

R-3. Ralston, O. C.

"Practical Applications of Electrostatic Phenomena to Particulate Matter," Paper presented AIEE Winter General Meeting, New York, N.Y. (January 30-February 3, 1956).

R-4. Randall, J. M., W. R. Marshall, Jr., and J. L. Tschernitz

"The Atomization of Liquids by High Voltage Electrical Energy," Presented at A.I.Ch.E. Meeting at Las Vegas, Nevada (September 22, 1964).

R-5. Rankine, A. O.

178. *Anomaly in Frictional Electricity.* A. O. Rankine. (Phys. Soc., Proc. 36. p. 430. Aug., 1924.)—An unpolished ebonite rod always becomes negatively charged when rubbed with flannel, but a similar polished rod can be got into such a state by prolonged beating with specially prepared flannel that it becomes negative when lightly rubbed by a piece of the prepared flannel, but positive when vigorously rubbed. Yet when the polished and the unpolished rods are rubbed together it is the *unpolished* that becomes positive. No explanation is offered.

PA-28-178

R-6. Rayleigh, Lord

"The Influence of Electricity on Colliding Water Drops," Proc. Roy. Soc. 28, 406-409 (1879).

R-7. Rayleigh, Lord

"Further Observations Upon Liquid Jets," Proc. Roy. Soc. 34, 130-145 (1882).

R-8. Reiss, M.

533. *Mobility of Liquid Particles of Radius* 10^{-5} *Cm., and their Electrical Charges.* M. Reiss. (Zeits. f. Physik, 39. 9. pp. 623-630, 1926.)—Following a procedure similar to that described by H. Trebitsch [see preceding Abstract], observations were made with particles of saturated barium mercury iodide (BaHgIH) of density 3·5 in nitrogen. The constancy of the levitating voltage at different gas pressures indicates constancy of the mass of the particles. With the above substance the normal law of resistance holds for particles of sizes down to 10^{-5} cm. radius. These particles had electrical charges of from $4{\cdot}72 \times 10^{-10}$ to $2{\cdot}27 \times 10^{-10}$ e.s.u., *i.e.*, less than the electronic charge.

PA-30-533

R-9. Remy, H.

4434* Aerosol Properties and Factors Affecting Them. (In German.) H. Remy. *Staub*, Dec. 15, 1951. p. 429-442. Combines review of literature with discussion of experimental and theoretical factors that affect behavior and properties of aerosols. Graphs, tables, and diagrams. 23 ref.

BMI 1-4434

R-10. Reshetov, V. D.

"Unipolar Charges of Aerosols"

Zh. Fiz. Khim 34, 1320-5 (1960)

The observed electrophoresis of aerosols is due to the generation of natt charges on the aerosol particles.

The sign of the charge depends on the acidity or alkalinity of the aerosol particles. If the pH of the drops or particles is less than 5 they appear negative with respect to the air, and if the pH is greater than this they appear positive.
The phenomena may be explained by selective adsorption of hydrogen ions.

Author

R-11. Reshetov, V. D.

Unipolar charges in aerosols. V. D. Reshetov. *Tr Tsentr. Aerolog. Observ.* 1959, No. 30, 53-61.

CA-57-14452h

R-12. Reynolds, S. I.

7038. SURFACE CHARGES PRODUCED ON INSULATORS BY SHORT- AND LONG-TIME IONIZATION. S.I.Reynolds. Nature (London), Vol. 183, 671-2 (March 7, 1959).
A rotating-probe electrometer (Abstr. 3227/1957) was used to study the distribution of surface charge on polyethylene and polyester resin surfaces after various electrical discharge treatments.

PA-61-7038

R-13. Rice, O. K.

752. *Surface Tension of Charged Surfaces.* O. K. Rice. (J. Phys. Chem. 30. pp. 1348–1355, Oct., 1926.)—The paper deals with the theory of charged surfaces and the accompanying phenomena. The electrostatics of the surface is treated mathematically and compared with the thermodynamic expression. The kinetics of the adsorbed ions is developed by aid of the Boltzmann probability principle.

PA-30-752

R-14. Richardson, E. G. (Ed.)

"Aerodynamic Capture of Particles," Pergamon Press, New York (1960).

R-15. Roberts, L. M.; C. E. Beaver, and W. H. Blessing

"Operating Experiences with Cottrell Precipitators on Sulfate Recovery Furnace Gases," Paper Trade J. 127, No. 18, 45-49 (October 28, 1948).

R-16. Robinson, M.

"A Miniature Electrostatic Precipitator for Sampling Aerosols--Theory and Practice," Anal. Chem. 33, 109 (1961).

R-17. Roy, L.

449. Electric Forces in a System of Isotropic Bodies. L. Roy. *Comptes Rendus*, 207. *pp.* 757–759, *Nov.* 2, *and pp.* 826–828, *Nov.* 7, 1938.—Expressions are developed for the resultant forces and moments on rigid and deformable dielectrics due to electric forces on the free charge and dielectric polarisation.

PA-42-449

R-18. Rüder, H. B.

"Entwicklung der Elektrischen. Gichtgasreingung und Neuere Betriebsergebnisse," Z. VDI-Beiheft, 3, 83-88 (1943).

R-19. Ruff, O.; G. Niese, and F. Thomas

2116. *Behaviour of Drops in Electric Fields.* O. Ruff, G. Niesé and F. Thomas. (Ann. d. Physik, 82. 5. pp. 631–638, March 22, 1927.)—The behaviour of drops of various organic and inorganic liquids in electric fields of high tension was investigated, especially as to the extent of the possibility of their electrostatic charge and as to illumination phenomena in their charged condition. Liquids were allowed to flow from a positively charged electrode at tensions up to 40,000 volts, and it was determined approximately up to what potential liquid drops, jets, or only mist were to be obtained, whether from them whilst still in contact with the electrode brush discharges took place, and whether after their separation from the electrode illumination was shown on their falling through the atmosphere or falling into liquid air. The results obtained with thirty-seven different substances are given in a table.

PA-30-2116

R-20. Ruff, O.; G. Niese, and F. Thomas

2115. *Electrometer Capacities.* O. Ruff, G. Niese and F. Thomas. (Ann. d. Physik, 82. 5. pp. 627–630, March 22, 1927.)—Details are given of an extension of Harms' drop method of determining capacities. Harms worked with a maximum tension of the drop electrodes of 220 volts. The authors have used high tensions up to 22,600 volts.

PA-30-586

R-21. Ruff, O.; G. Niese, and F. Thomas

2114. *Surface Tension and Electric Charge.* O. Ruff, G. Niese and F. Thomas. (Ann. d. Physik, 82. 5. pp. 618–626, March 22, 1927.)—A relation is developed for the dependence of the surface tension on the surface of a spherical conducting drop on the density of the electric charge. This relation is experimentally confirmed for mercury.

PA-30-2114

R-22. Rumpf, H.

"The Strength of Granules and Aggregates," pp. 379-418 in "Agglomeration," W.A. Knepper, Ed. Interscience Publishers, New York (1962).

R-23. Rumpf, H.

"Grundlagen und Methoden des Granulienens," Chem.-Ing.-Tech., 30, 144 (1958).

In ersten und zweiten Teil dieser Arbeit wurden Begriffe, Anwendung und Eigenschaften der Granulate sowie die physikalischen Grundlagen der Kornvergrößerungen behandelt. Der im dritten Teil gegebene Überblick über die technischen Granulier-Verfahren umfaßt die Zerkleinerungs- und Kornvergrößerungs-Verfahren. Bei allen Methoden müssen mehrere Verfahrensstufen zusammenwirken. Die Größeneinstellung überläßt man dabei meist einem Klassiervorgang. Für die verschiedenen Methoden des Granulierens werden neben schematischen Darstellungen der verwendeten Geräte übersichtliche Fließschemata der Verfahren gebracht.

Author

S-1. Sachsse, H.

5135. Electrical Peculiarities of Dust and Mist. H. Sachsse. *Ann. d. Physik*, 14. 4. *pp.* 381–412, *Aug.* 1, 1932.—The method first used by Ehrenhaft and Millikan to determine the charge on particles of oil was applied to find the charge in the case of a number of kinds of smoke and mist and to investigate the relation between charge and magnitude of particles and the nature of their origin and previous treatment. The following results were obtained from experiments with the Millikan condenser and Faraday cage: (1) The diffused substances or aerosols As_2O_3 NH_4Cl, SO_3, $TiCl_4$, and paraffin oil got by condensation from the state of vapour are uncharged. (2) Aerosols obtained by dispersion into dust of liquid substances with air under pressure are likewise uncharged. (3) Aerosols obtained by other methods—explosion, combustion, whirling action with compressed air, so-called "friction"—are fully charged, apparently half + and half −. (4) The charges produced by "friction" are approximately proportional to the square root of the radius of the particle and carry about one-third of the maximum charge which a particle obtains in the negative field of a corona discharge (field strength 6·5 c.g.s. units). Thus an MgO particle of 1×10^{-4} cm. radius carries about 100 elementary charges. (5) The charge of the whole cloud depends as to magnitude and sign on the conditions of origin of the cloud and perhaps before all on the influence of friction at the origin. (6) By friction, charges of both signs and of great magnitude can be given to dust—*e.g.*, 30 e.s.u. per gm.

PA-35-5135

S-2. Salceanu, C.

7417 DROP OF LIQUID FALLING IN AN ELECTRIC FIELD. C.Sălceanu.
C.R.Acad. Sci. (France), Vol. 256, No. 2, 410-12 (Jan. 7, 1963).
In French.

A study was made of the effect of applied potential difference and of falling distance to the stage of an electrometer during the fall of water droplet. From the similarity in the behaviour of water and dipolar liquids, e.g. acetone and nitrobenzene, the importance of small traces of impurities is stressed. Under the action of an auxiliary field surface polarization of charges occurs, an increased field producing increased displacement of positive and negative charges.

PA 66-7417

S-3. Salceanu, C., and O. Birau

7217 ELECTRICAL POTENTIAL ACQUIRED BY FALLING DROPS OF LIQUIDS. C.Sălceanu and O.Birău.
C.R. Acad. Sci. (France), Vol. 256, No. 1, 142-4 (Jan. 2, 1963).
In French.

An experimental study of the influence of dipole moment in the liquid upon the charge acquired by drops leaving a charged electrode. Polar liquids tend to acquire a like potential to the electrode while non-polar liquids appear to show no effect.

PA 66-7217

S-4. Salceanu, C., and G. Birau

1376 ELECTRICAL BREAKDOWN POTENTIAL OF FALLING LIQUID DROPS, FORMED BY DETACHMENT FROM A LEVEL SURFACE. C.Sălceanu and O.Birău.
C.R. Acad. Sci. (France), Vol. 253, No. 16, 1657-8 (Oct. 16, 1961).
In French.

Water and various organic liquids are examined at 23°C. A linear relation is found between the measured breakdown potential and the permanent dipole moments of the appropriate liquid.

PA-65-1376

S-5. Salceanu, C., and S. Zeno

355 THE ELECTRIC POTENTIAL OBTAINED BY LIQUID DROPS FALLING UNDER GRAVITY.
C.Sălceanu and S.Zeno.
C.R.Acad. Sci. (France), Vol. 255, No. 9, 1299-1301 (Aug. 27, 1962).
In French.

Continuation of the work described in Abstr. 1376 of 1962 showed that the potential does not depend on the diameter of the tube from which the drops are detached. A table of potentials for water and nine organic liquids is given. The potentials are all negative and not positive as stated in error previously. The potential is explained as being an elastic potential due to the orientation of the liquid molecules.

PA-66-355

S-6. Sanzenbacher, R.

432. *Electric Charges on Vaporised Particles.* **R. Sanzenbacher.** (Zeits. f. Physik, 39. 4. pp. 251–275, 1926.)—A comprehensive series of measurements of the electric charge carried by mercury particles was made under various conditions in the three gases, air, hydrogen and CO_2. The results obtained show that mercury particles which are subjected to a relatively rapid vaporisation or condensation give normal values for the electric charge in CO_2 and in air both when the radius of the particles is less than 10^{-5} cm. and in the region in which as a rule sub-electrons are produced. In hydrogen normal charges were in general only found with particles subjected to strong vaporisation. Apparent variations of the elemental charge were obtained with mercury particles whose vaporisation was hindered. The bearing of these results on Regener's theories [see Abstract 907 (1921)] is discussed.

PA-30-432

S-7. Sartor, J. D.

20836 CALCULATIONS OF CLOUD ELECTRIFICATION BASED ON A GENERAL CHARGE-SEPARATION MECHANISM. J.D.Sartor.
J. geophys. Res. (USA), Vol. 66, No. 3, 831-8 (March, 1961).

Using recent solutions for the electrostatic and hydrodynamic two-body problems of the fields and forces between freely falling spheres in an electrostatic field, quantitative computations are made of the effectiveness of a general theory of cloud electrification that considers all particles in a cloud to be polarized by the electrostatic field of the atmosphere, and rebounding encounters to result in the transfer of charge in the direction required to increase the existing fields. The calculations employing observed cloud- and rain-drop size distributions give electrostatic fields of the magnitude observed in the time required for the development of a thunderstorm.

PA-64-20836

S-8. Sartor, J. D.

551.5 : 621.316.98

16491 SOME ELECTROSTATIC CLOUD-DROPLET COLLISION EFFICIENCIES. J.D.Sartor.
J. geophys. Res., Vol. 65, No. 7, 1953-7 (July, 1960).

Recent electrostatic and hydrodynamic solutions to the two-body problem of the forces on neighbouring spheres are combined to determine the motion of cloud droplets in a uniform electrostatic field. Collision efficiencies are obtained from the relative trajectories of one droplet with respect to another both with and without the electrostatic field. The collision efficiencies are compared to demonstrate the effect of electrostatic fields in the initial stages of droplet accretion. It is concluded that fields commonly observed in clouds can play an important role in the collision and coalescence of the droplets.

PA-63-16491

S-9. Satô, M.

347. *Contact Electric Layers.* M. Satô. (Tôkoku Univ., Sci. Reports, 14. pp. 313-320, July, 1925. In English.)—In a previous paper [Abstract 726 (1923)] the author has reported that when certain melted dielectrics, such as wax or resin, are solidified on a metallic plate, and then separated from it, some surface charge appears on the contact surface of the dielectrics. The present investigation has been undertaken to make the nature of this charge clearer. First, the signs and relative values of the surface densities of the charge when resin or wax is brought into contact with several metals have been determined. Henning's measurements of the contact electric potentials are included. Next, experiments are described to test whether the surface charge is distributed only over the surface of the dielectrics or penetrates them to some extent; and also to decide whether the electric layers are caused by bringing the solid dielectrics and metals into contact. It is inferred that the apparent surface charge consists of double electric layers, one intense and near to the contact surface, the other weaker, farther away, opposite in sign and much thicker. The conclusion is drawn that the electric layers are caused only by the contact of dielectrics with metals or other dielectrics. Eleven diagrams and two tables of data are included.

PA-29-347

S-10. Schaefer, V. J.

"The Electrification of Oil and Water Clouds," pp. 431-4 in "Recent Advances in Atmospheric Electricity," L. G. Smith, editor. Pergamon Press, 1958. 631 pp.

S-11. Schaffert, R. M.

"The Nature and Behavior of Electrostatic Images," Photographic Sci. and Eng., 6, No. 4, 197-215 (July-August, 1962).

S-12. Scheffy, W. J.

Properties of aerosol agglomerates. W. J. Scheffy *U.S. Atomic Energy Comm.* TID-7513(Pt.1), 202-206(1959).

CA-50-16002b

S-13. Schirmann, M. A.

997. Existence of an Electrification due to Friction between Solid Bodies and Gases. Part I. M. A. Schirmann. *ZS. f. Phys.* **40. 3-4.** *pp.* 209-236, 1927.

Experiments are described which throw light on the mode of production of electrification when a stream of mercury vapour is shot through a glass tube. The apparatus consists virtually of a mercury-vapour jet pump. The electrification causes a luminous discharge which can be photographed. Two frictional effects are differentiated: (*a*) rubbing of condensed drops of mercury on the glass, and (*b*) rubbing of the vapour itself on the glass. The former alone is active for low velocities of the mercury-vapour stream. At higher velocities the disposition of the luminosity in the apparatus shows definitely the existence of the latter effect. Measurements of the decay period of the luminosity were also made. It is suggested that at the surface of a solid an electrical double layer is formed of which at least the outer layer lies in the film of gas or moisture adhering to the surface, and can be mechanically disrupted by the " rubbing " of a gas.

PA-31-997

S-14. Schlick, Ernst

"Electrically Charged Atomizer for Liquids," German Patent 967, 496 (November 14, 1957).

S-15. Schmidt, W. A., and E. Anderson

"Electrical Precipitation," Elec. Eng. 57, 332-338 (August 1958).

S-16. Schmitt, K. H.

4741 INVESTIGATIONS ON SUSPENDED PARTICLES IN A TEMPERATURE GRADIENT. K.H.Schmitt. Z. Naturforsch., Vol. 14a, No. 10, 870-81 (Oct., 1959). In German.

To avoid convection currents the upper condenser plate in a kind of Millikan experiment was maintained at the higher temperature. Droplets of various silicone oils and kerosine were examined in argon, nitrogen, carbon dioxide, and hydrogen. Stokes' law applies for large particles, whereas for particles of less than 1μ radius a correction factor must be applied. The experimentally determined constants for this factor were about 10% larger than the theoretical values, when no temperature gradient had been applied. H_2 has the greatest proportion of elastically reflected molecules. With a constant temperature gradient of 49.4 deg C/cm a temperature difference on the suspended particles which obeyed the condition $r/\lambda > 5$ was verified in a model experiment on macroscopic spheres in a vacuum. The velocity of the particles was found to be independent of their radius in the ranges of small and of comparatively large particles. For large particles the heat transport through the particle and through the gas were also of importance.

PA 63-4741

S-17. Schnitzler, H., and J. Somolyai

* **Effects of the Electrical Charge on the Coagulation of Dust.** Describes a method to measure the relationship between the electrical charge and the coagulation of a dust cloud under constant climatic conditions. The distribution of the rates of vertical descent is measured with an electrical recording microbalance according to Gast. At the same time, the state of charge of the whirled-up dust is recorded by a double condenser and two electrometer amplifiers. Some initial results are given. (*In German.*) Einfluss der elektrischen Aufladung auf die Koagulation von Staub. ***Hermann Schnitzler and Josef Somolyai. Staub,*** v. 21, June 1, 1961, p. 241-246.

BMI 10-911a

S-18. Schnurmann, R.

2186. Contact electrification of solid particles. R. SCHNURMANN. *Proc. Phys. Soc., Lond.*, 53, *pp.* 547–553, *Sept.*, 1941.—Solid particles carry with them electrostatic charges from contact with the storage vessel. The sign of the charge acquired in the air of the laboratory was determined for metal particles which were poured either from a silica bowl or from a glass beaker, and for particles of insulators and semi-conductors which parted contact with containers of silica, glass or various metals. A closed, insulated metal funnel which is connected to an electroscope receives the charge which the particles carry with them from contact with a container from which they are poured. When the particles are made to stream from the funnel after the electrostatic charge has been removed from it, the funnel again acquires a certain charge, while the particles carry the opposite charge with them to the receptacle. Copper filings poured from a container of either glass or silica assume a positive charge, and silica particles poured from a copper trough assume a negative charge, while silica in bulk assumes a positive charge when it is rubbed against copper in bulk. Sb powder poured from a container of either glass or silica assumes a negative charge, and both glass and silica in bulk rubbed against a block of Sb assume a positive charge.

PA-44-2186

S-19. Schnurmann, R.

1292. Fleming's method of electrification and Coehn's electrostatic experiments. R. SCHNURMANN. *Phys. Soc., Proc.*, 52, *pp.* 179–183. *March*, 1940.—Silica flour poured from a glass beaker or a copper trough carries negative charges away. The silica particles acquire these charges while in contact with glass or copper walls at room temperature. With the sole exception of what is known as "waterfall electrification", cases of electrification through friction or through impact are in fact cases of contact electrification. The sign of the charges separated depends on the work function and the solution pressure of the metal with respect to the dielectric. The action of rubbing an insulator against a metal, for instance, silica in bulk against copper in bulk, can lead to an inversion of the sign of the static charges acquired; the silica can assume a positive charge. This is ascribed to the dependence upon temperature of the migration of positive ions from the metal to the insulator. The action of rubbing thus has two functions: firstly, it helps to establish intimate contact between two solids, and secondly, in the atmosphere it abrades particles from noble metals. In addition, in the case of less noble metals the rise of temperature of the surface irregularities increases the ability of the surface of the dielectric to accept positive ions. [See Abstracts 375 (1922), 456 (1925) and 2632 (1939).]

PA-43-1292

S-20. Schoen, G.

Electrostatic charge-forming phenomena and ignition danger. A summary of available results. G. Schoen (Phys.-Tech. Bundesanstalt, Braunschweig, Ger.). *Chem.-Ing.-Tech.* 34, 432-6(1962).

CA-57-7052g

S-21. Schonland, B. F. J.

"Atmospheric Electricity," 2nd Ed., John Wiley and Sons, Inc., 95 pp. (1953).

S-22. Schultze, K.

4997 THE BEHAVIOUR OF DIFFERENT LIQUIDS DURING ELECTROSTATIC ATOMIZATION. K.Schultze. Z. angew. Phys. (Germany), Vol. 13, No. 1, 11-16 (Jan., 1961). In German.

The liquids investigated were classified according to their electrical conductivity, ranging from highly insulating transformer oil to aqueous salt solutions. The liquids were allowed to issue from fine glass or metal jets, a voltage of up to 12 kV being applied with respect to a plane 15 mm below this orifice. The nature of the atomization was observed and the quantity of liquid dispersed per unit time measured. Optimum results were obtained with liquids in the conductivity range 2×10^{-8} to 6×10^{-6} ohm^{-1}cm^{-1}. The effects of hydrostatic pressure, orifice diameter and viscosity of the liquid were also studied.

PA 65-4997

S-23. Schumann, T. E. W.

2560. *On Elster and Geitel's Theory of the Electrification of Raindrops.* T. E. W. Schumann. (Phys. Rev. 26. pp. 105–110, July, 1925.)—The following experiments were made to test Elster and Geitel's theory of the electrification of raindrops. Large drops (A drops) falling between below with a fine stream of small drops (B drops), and the charge on the A drops was found to be of the same sign as that of the upper plate and to be proportional to the field strength. From the charge per A drop and the probable number of collisions with B drops the charge per collision was computed and found to be zero for B drops of radius less than 0·18 mm. and then to increase rapidly with the radius to 0·4 mm. Photographs taken with a motion-picture camera show that the B drop first coalesces with the A drop, and then, if its momentum is sufficient, a protuberance is produced on the upper surface of the A drop which breaks up into a number of small droplets, which carry off with them not only part of the A drop, but also some charge. Very small B drops probably merely coalesce with A drops. In the case of falling rain, cloud droplets are too small to have a charging effect, and the effect of larger drops overtaking smaller ones is to weaken the existing field. Hence it is doubtful whether this phenomenon alone can explain the observed charges on raindrops, and it certainly does not explain such high potential differences as occur in lightning discharges.

PA-28-2560

S-24. Schweitzer, H.

2273. Charging of Particles Suspended in a Corona Discharge. H. Schweitzer. *Ann. d. Physik*, 4. 1. *pp.* 33–48, *Jan.* 18, 1930.

The charging of small drops of paraffin oil suspended in a corona discharge has been studied in order to determine (*a*) the magnitude of the charge; (*b*) the relationship between the radius of the particle and its charge. Further, since earlier studies of the purification of gases by electrical precipitation have not revealed whether the highly charged particles occur to a large extent and play a large part in the purification, this point has also been investigated. It is found that over the range of the concentration of ions in the corona the charge is almost independent of the concentration. The charge increases almost linearly with increase in the radius of the particle. Finally, in the electrical purification of gases highly charged particles occur rarely and are of no importance to the process.

PA-33-2273

S-25. Sergiyeva, A. P.

Sergiyeva, A. P.
THE ELECTRICAL CHARGES OF CLOUD PARTICLES (Ob Elektricheskikh Zaryadakh Oblachnykh Chastits) tr. by John Miller. Oct 58 [19]p. 19 refs. Order from LC or SLA m#2.40, ph$3.30 59-16022

Trans. of °Akademiya Nauk SSSR. Izvestiya. Seriya Geofizicheskaya, 1958, no. 3, p. 247-257.

A method and an instrument are described for the simultaneous measurement of individual electrical charges of particles from a sample containing from 50,000 to 100,000 droplets. The operating principle of the instrument is measurement of charges of the very small particles of solid aerosols, based on the precipitation of the particles from an air stream into an electric field. The number of charged droplets in an artificial cloud is shown to be a function of the length of time the cloud exists: the dispersion of charges in natural clouds increases with an increase in the size of the particles.

T2-782

S-26. Sexl, T.

2819. *On the Problem of the Electrical Charges of Sub-Microscopic Particles. II.* T. Sexl. (Zeits. f. Physik, 26. 6. pp. 371–378, 1924.)—The present paper contains a revised mode of calculation for the Derieux data [see Abstract 454 (1918)] compiled by the Ehrenhaft-Millikan method with respect to the fall period of mercury drops at different pressures. This has afforded not only a determination of particle size free from objection, but also a constant of the Stokes-Cunningham resistance law which deviates appreciably from that given by Millikan for mercury-air. Since this necessitates deviations in the particle charges from electronic values, Ehrenhaft's conclusion appears to be confirmed, *viz.* that charges are stable upon microscopic and submicroscopic metallic particles in a similar manner to those on dielectric particles.

PA-27-2819

S-27. Sexl, T.

2014. *The Electric Charges on Submicroscopic Particles.* T. Sexl. (Zeits. f. Physik, 16. 1. pp. 34–41, 1923.)—This paper is in part a comment on the work of L. Schiller [see Abstract 1633 (1923)]. Bär [see Abstract 2005 (1922)] is of the opinion that ultramicroscopic particles possess an appreciably smaller density than the original compact material from which they have been derived, and that through this smaller density the occurrence of subelectrons during charge measurements may be conditioned. Ehrenhaft on the other hand has emphasised the extreme improbability of the occurrence of Pt-particles of density 0·2, and dismisses Bär's assumptions as to the condition of the particles on the ground of the resistance law, also that Bär has 3 equations with 4 unknowns for the density determination of submicroscopic particles. Schiller has attempted to answer Ehrenhaft's objections by the assumption of non-spherical particles. The present author now attempts to show that neither the Schiller view, nor that of Bär, nor the Kaufmann-Regener assumption of an adsorbed gas layer at the surface of the particles, affords a critical explanation, and that a purely experimental determination of a resistance law for the motion of small spheres in gases, independent of any assumption as to the constitution of the electricity, must be obtained to solve the problem.

PA-26-2014

S-28. Shale, C. C.; W. S. Bowie, and J. H. Holden

"Characteristics of Positive Corona for Electrical Precipitation at High Temperatures and Pressures," RI 6397, U.S. Dept. of Interior, Bur. Mines (1964).

Electrical characteristics of positive corona are presented for air in a 2-in-diam electrostatic precipitator operating under dynamic conditions at temperatures of 600° to 1,500° F and pressures of 0 to 80 psig. Results show that current-voltage relationships depend solely on air density. Comparison of data on positive corona with previously published data on negative corona demonstrates a higher sparkover voltage and a wider range of operability for positive corona at temperatures above 375° F. The possibility of achieving higher voltages with positive polarity as indicated by these experiments implies several advantages for the use of positive corona in precipitators to allow better removal of suspended material from hot gases.

Based on the physics of an ion in an electrical field, a theoretical equation is derived to define current-voltage characteristics of positive corona in terms of air density. Constants for the equation are evaluated from test data. Calculated current-voltage values at different air densities agree reasonably well with experimental data.

Author

S-29. **Shapiro, A. R., and W. K. R. Watson**

"An Electrodynamic Foucault Pendulum," J. App. Phys. 34, 1553 (1963).

The trajectories of a single charged particle trapped in an electrodynamic, quadrupolar-containment device are studied in a uniformly rotating coordinate system, in an attempt to simulate the behavior of a Foucault pendulum.

Author

S-30. **Shaw, P. E.**

1616. Triboelectricity and Friction. Part IV. Electricity due to Air-blown Particles. P. E. Shaw. *Roy. Soc., Proc.* 122. *pp.* 49–58, *Jan.* 1, 1929.

Experiments are described which are designed to explain such effects as electric sandstorms and snowstorms, electric flashes seen in the ejecta-menta from volcanoes, and electric charges and sparking of organic powders in certain industrial processes. In this group of effects charges are produced by the impact of like particles. The apparatus used provides for the separate measurement of the charges arising on wind-blown particles, on surfaces of one material on which the particles are blown, and on the issuing air. It is shown that considerable charges arise, even when the particles and surfaces are chemically identical, thus indicating that the Volta effect is not sufficient to account for all the charge. Physical differences of the surface, *e.g.*, strain effects, are, therefore, suggested as contributory factors to triboelectric charges.

PA-32-1616

S-31. **Shaw, P. E.**

"Electrical Separation Between Identical Solid Surfaces," Proc. Phys. Soc. 39, 449 (1927).

S-32. **Shaw, P. E.**

1102. *Electrical Charges from Like Solids.* P. E. Shaw. (Nature, 118. pp. 659–660, Nov. 6, 1926.)—The author summarises a series of experiments made on a number of substances in tests of tribo-electricity. He states three general principles: (*a*) really identical surfaces charge one another according to a definite rule; (*b*) friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising and by the fact that heating restores the surface; and (*c*) rough impact between like bodies in general leaves them with unequal charges. It is thought (*a*) and (*c*) may give a solution for the origin of electric sand storms and dust storms. [See also Abstract 2423 (1926).]

PA-30-1102

S-33. **Shaw, P. E., and R. F. Hanstock**

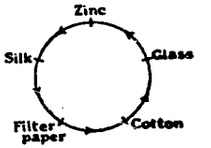
214. Triboelectricity and Friction. Parts V and VI. Surface Strain and Relaxation of Like and Unlike Solids. P. E. Shaw and R. F. Hanstock. *Roy. Soc., Proc.* 128. *pp.* 474–487, *Aug.* 5, 1930.—It has been shown [see Abstract 1616 (1929)], that charges arise when two identical surfaces are rubbed together. The effects are attributed to progressive strain on the surface, brought about by pressure and friction. In the present papers these effects are standardised by employing definite areas, known forces and stated temperatures. Complete recovery from strain can be attained by rise of temperature. Curves are given showing voltage attained by a given number of rubs between the surfaces. In the experiments described in Part V like materials are used; in Part VI the materials are unlike. In the second case the charges are much larger and change sign with a fewer number of rubs. Experiments in vacuum give results similar to those in open air; the effects are thus claimed to be entirely due to changes in the solid surfaces. The two factors which complicate results obtained in frictional electricity are (1) surface strain; (2) deposition of organic film on the surface derived from fabrics, etc. The authors show that the former may be minimised by carrying strain to the limit, and the latter eliminated by avoiding rubbers such as fabrics.

PA-34-214

S-34. **Shaw, P. E., and C. S. Jex**

1671. Tribo-Electricity and Friction. Parts II and III. P. E. Shaw and C. S. Jex. *Roy. Soc., Proc.* 118. *pp.* 97–113, *March* 1, 1928.

Part II. Glass and Solid Elements.—Quantitative results are aimed at, the two surfaces being pressed together with a definite force and rubbed over a definite length. After each rub, the deflection of an electroscope is noted. Curves are given showing the results. Some elements (*e.g.*, C, Cd, Fe, Pb, Bi, Ag, etc.) never show a negative charge. Others (such as Zn, Sn, Al, Sb, Ni, Co, Cr, S) show ultimate negative charge. Evidence is given of the predominating influence on the charging of residual acid, alkali, or water film on the glass. The results appear to be the same when the rubbing is done *in vacuo* as in the open air. Reference is made to various theories on the subject, and it is urged that triboelectricity cannot be a purely statical effect; the kinetic effects must be important and may be paramount.



Part III. Solid Elements and Textiles.—Apparatus and methods used are the same as in Parts I and II, except that the element is rubbed, not on glass, but on the textile wrapped round glass rods. The results for the solid elements rubbed with silk, cotton, and specially prepared filter-paper are shown diagrammatically beside the corresponding results for glass given in Part II. It is shown that it is impossible to devise a simple tribo-electric series of one column to include all solids. For example, the five materials, zinc, silk, filter-paper, cotton, glass, are related in a continuous ring as in the figure, the arrow in each case pointing from positive to negative.

PA-31-1671

S-35. **Shaw, P. E., and C. S. Jex**

2423. *Tribo-electricity and Friction.* **P. E. Shaw and C. S. Jex.** (Roy. Soc., Proc. 111. pp. 339–355, June 2, 1926.)—Changes in the condition of glass surfaces when rubbed with flexible materials like cotton, linen and silk, are dealt with, measurements being made of (*a*) the electric charges displayed by the glass surfaces; (*b*) the coefficient of friction found between two of them after identical rubbing. The Hankel form

of electroscope is used, and a special tilting apparatus for measurement of the coefficient of friction (μ). Amongst the definite effects found are: (1) Owing to adsorption of condensable material the μ of a glass surface slowly descends from 1·2 to about 0·7; (2) ordinary textile materials rubbed on glass quickly reduce μ; (3) very clean textile materials slowly reduce μ; (4) a low value of μ is raised by heating the glass or placing it in a vacuum or in air; (5) the sign of the charge can be made + or − according as the rubbing is along or across the fibre of the yarn used; (6) if one of two identical surfaces of glass be heated and then rubbed on the other, it becomes negative to it.

PA-29-2423

S-36. Sher, Lawrence D.

AD-409 089 Div. 16, 25
(TISIA/AD) ots price $12.00

Moore School of Electrical Engineering, U. of Pennsylvania, Philadelphia.
MECHANICAL EFFECTS OF AC FIELDS ON PARTICLES SUSPENDED IN A LIQUID; BIOLOGICAL IMPLICATIONS, by Lawrence D. Sher. 1963. 151p. Technical rept. no. 77
Contract Nonr55105

Unclassified report

Doctoral thesis.

Descriptors: (*Particles, Electrical properties), Alternating current, Electrophoresis, Test equipment, Microscopes, Electric fields, Electroosmosis, Dielectric properties, Thresholds (Physiology), Electrical conductance, Cells (Biology), Liquids, Polarization, Electrical impedance, Configuration, Erythrocytes, Escherichia, Spheres, Dipole moments, Proteins, Bubbles, Geometry, Microscopy, Electrodes, Theory, Microwaves, Mechanical properties.

Identifiers: 1963, Pearl chain formation.

A study of the mechanical effects of AC fields is greatly simplified when these effects can be directly observed. Therefore the simplest physical system which would conveniently exhibit the desired behaviour, a suspension of microsized particles in a simple liquid was used. Four distinct mechanical effects were observed: (1) Forces in inhomogeneous fields, (2) AC electrophoresis, (3) orientation of non-spherical particles, and (4) pearl-chain formation. The first three may be observed on single particles in the field, but the fourth is an interaction between two or more particles brought on by their combined exposure to the field. (Author)

S-37. Shire, E. S.

"Survey of Electrostatic Generators," Brit. J. App. Physics, Supp. 2, 556 (1953).

S-38. Shulepov, Yu. V., and S. S. Dukhin

N64-18676 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IN REFERENCE TO THE THEORY OF ELECTRICAL COAGULATION OF SPHERICAL AEROSOL PARTICLES
Yu. V. Shulepov and S. S. Dukhin 17 Jul. 1963 8 p refs Transl. into ENGLISH from Kolloid. Zh. (Moscow), v. 24, no. 6, 1962 p 749-751
(FTD-MT-63-70/1+2; AD-434958)

From a consideration of the elementary act of electrical coagulation of aerosol particles as a two-body problem, formulas have been derived for the capture efficiency for an arbitrary ratio of the particle radii. The known formulas for capture efficiency, derived on the basis of the elementary electrical coagulation, act as a one-body problem and are particular cases of the formulas derived in the present study.

N64-18676, 11-23

S-39. Siksna, R.

1794. CHARGED CONDENSATION NUCLEI FORMED IN A ROOM BY CORONA DISCHARGE WHEN ALTERNATING THE POLARITY OF THE CORONA POTENTIAL AND BY USING ALTERNATING CORONA POTENTIAL. R.Siksna. Geofis. pura appl., Vol. 31, No. 2, 39-49 (1955).

The content of charged nuclei formed in a room varied by alternating the polarity of a corona device and depended on the period during which the corona of one polarity was switched on. The concentration of charges measured was greater during the negative period than during the positive one, when the action period of corona of one polarity was 30 minutes, but it was the opposite for the period of 5 minutes. When using alternating corona potential of 50 cycles per/sec only positively charged nuclei were established. By using alternating potential the picture was changed when air was blown through the corona device: the content of positively charged nuclei was diminished and negatively charged nuclei were also observed. An air circulation produced by the convection from an electric heater placed below the corona device was sufficient to cause a similar effect.

PA-60-1794

S-40. Silsbee, F. B.

"Systems of Electrical Units," Nat. Bur. Stds, J. Research, 66C, No. 2, 137-178 (April-June, 1962)

See also;

Nat. Bur. Stand. Monogr. (USA), No. 56, 1-42 (1962).

The various systems of measurement, with their respective sets of units, used in the literature on electricity and magnetism are described in detail. Their historical development is summarized. The manner in which each is derived from either of the two alternative points of view of the experimentalist and the theoretician is compared and contrasted. The desirability of recognizing both points of view in international standardization, particularly when discussing rationalization, is pointed out. The present state of the absolute measurements on which all electrical units are based is reported, and tables are included for the conversion of equations and numerical values from one system to another.

PA 65-1905

S-41. Silsbee, F. B.

"Static Electricity," Nat. Bur. Stand. Circular No. C-438 (1942).

S-42. Silverman, L; F. V. Conners, and D. M. Anderson

"Mechanical Electrostatic Charging of Fabrics for Air Filters," Ind. Eng. Chem. 47, 952-960 (1955).

S-43. Simon, A. W., and L. C. Kron

"Electrical Precipitation," Elect. Engr. 51, 93-95 (1932).

S-44. Simpson, G. C.

Electricity of cloud and rain. Simpson, G. C. *Quart. J. Roy. Met. Soc.*, 68, *pp.* 1-34, *Jan.*, 1942.—Apparatus is described for measuring the electricity associated with relatively large quantities of rainfall and for measuring the charges on individual drops. Precipitation of all kinds is sometimes positively and sometimes negatively charged. The various theories which have been proposed to account for the origin of this electricity and its observed distribution in clouds are critically discussed. The negative charge in the upper part of clouds below 0°C. are explicable by the collision of ice particles; the positive charges in the rain region may be due to the breaking of drops or to the absorption of ions in an electric field; but no theory satisfactorily explains the positive charge invariably found on steady rain.

PA-45-2006

S-45. Simpson, G. C.

"The Electricity of Atmospheric Precipitation," Phil. Mag. 30, 1-12 (1915).

S-46. Simpson, G. C.

"The Electricity of Rain and Snow," Proc. Roy. Soc. A, 114, 376-401 (1910).

S-47. Simpson, G. C.

"On the Electricity of Rain and its Origin in Thunderstorms," Phil. Trans., A209, 379 (1909).

S-48. Singer, S; Mak Goo Kim, and M. Farber

"An Experimental Study of Colloidal Propulsion Using Sub-Micron Solid Particles," AIAA Electric Prop. Conf., Colorado Springs, Paper No. 63052-63 (March 11-13, 1963).

S-49. Shelekhina, A. L. et al.

Selection of solvents for paints sprayed in an electrical field. A. L. Shelekhina. M. I. Stepanova, A. V. Mashlykina, and N. S. Serebryanikov. *Lakokrasochnye Materialy i ikh Primenenie* 1964(3), 42-4.

CA-8518c

S-50. Slade, F. H.

1452 **Foreign Particles in Gases.** Frank H. Slade. *Machinery Lloyd (Overseas Ed.)*, v. 26, Sept. 25, 1954, p. 71, 73-82.
Principles of gaseous suspensions. Equipment for purification and dust collection. Graphs, tables, diagrams.

BMI 4-1452

S-51. Smith, L. G.

6660. **The electric charge of raindrops.** L. G. SMITH. *Quart. J. Roy. Meteorol. Soc.*, 81, 23-47 (*Jan.*, 1955).

The observations were obtained using equipment designed to record rapidly, and without ambiguity, the electric charge and size of individual raindrops. The electric charge is measured by electrostatic induction on a metal cylinder as the drop falls through. The size of the smaller drops is determined from the time of fall between two such cylinders, while the size of the larger drops is measured by the change of capacity of a parallel-plate condenser as the drop passes between the plates. The point-discharge current, electric-field strength and rain current were also measured. The observations show that on all occasions the range of charge on a particular size of drop is large, often including both signs, and that this range is not appreciably reduced by considering drops recorded during shorter time intervals. However, it is often found that the average charge and the limits of the range of charge show definite relations to the size of the drop. The variation of average charge is such that there is a certain size for which the average charge is zero; for smaller drops the average charge is opposite in sign to that of the electric field, while the larger drops have average charges of the same sign as that of the electric field. On some occasions the charges on the drops are too small to be recorded. The field is then usually reversed to a small negative value. It is suggested that the drops are falling from electrically neutral or slightly electrified clouds, the reversal of the field resulting from the splashing of drops on the ground. The capture of ions by raindrops falling in the region of the point-discharge current below an electrified cloud is examined and it is shown that, if reasonable assumptions are made about the initial charges on the drops, the relation between the charge and size of drops arriving at the ground is similar to that found experimentally. Comparison of theory and experiment indicates that the field increased with height owing to the point-discharge space charge. The range of charge is attributed to the mixing, while falling, of drops leaving the cloud base in regions of different current density. This requires that the regions of high current density are small areas of the cloud base, probably not exceeding 100 m in diameter.

PA-58-6660

S-52. Smythe, W. R.

1689? CHARGED SPHEROID IN CYLINDER. W.R.Smythe.
J. math. Phys. (USA), Vol. 4, No. 6, 833-7 (June, 1963).

The problem of a charged conducting spheroid within a coaxial conducting cylinder is solved by a slight variation of an earlier method (see Abstr. 3973 of 1960). Errors in the terminal digits of Table I in that paper are corrected and the table extended. The charge density on the spheroid, the potential between it and the cylinder, and its capacitance are given for ratios of the spheroid equatorial radius to cylinder radius of 0·1, 0·2, 0·3, 0·4, 0·5, 0·6, 0·7, 0·8, 0·9, and 0·95. Tables give numerical results for five cases: the disk, the oblate spheroid with 2 to 1 axial ratio, the sphere, and the prolate spheroid with axial ratio 1 to 2. The thin prolate spheroid requires special treatment.

PA-66-16897

S-53. Smythe, W. R.

CHARGED SPHERE IN CYLINDER.
8973 W.R.Smythe.
J. appl. Phys., Vol. 31, No. 3, 553-6 (March, 1960).

The method first used to solve the problem of a freely charged right circular cylinder (see Abstr. 8159 of 1956), is applied to the case of a charged conducting sphere enclosed by a coaxial circular conducting cylinder. The charge density on the sphere, the potential between it and the cylinder and the capacitance are given for sphere to cylinder radius ratios of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 0.95. All results are accurate to one part in 10^7 or better. An approximate formula for the capacitance of a sphere in a cylindrical box is given.

PA-63-8973

S-54. Smythe, W. R.

8159. CHARGED RIGHT CIRCULAR CYLINDER.
W.R.Smythe.
J. appl. Phys., Vol. 27, No. 8, 917-20 (Aug., 1956).

A new method permits the calculation of the electric field surrounding a charged conducting surface of revolution without the use of orthogonal functions. Detailed formulae show how to find the charge density on a right circular cylinder with any desired precision. The numerical examples worked out give the maximum deviation of the actual surface from that of a true cylinder of diameter d to be −0.0015d, −0.00037d, −0.00017d, +0.0016d, and +0.014d for length to diameter ratios $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4, respectively. The capacitance calculation gives an accuracy of one part in 30 000 for the ratios $\frac{1}{2}$, 1, and 2. A capacitance formula is worked out which is accurate to one part in 1000 over the ratio range 0 to 4. Additional formulae indicate the method of solution for the bodies in longitudinal and transverse electric fields and the extension of two-body problems such as the thick plate parallel plate capacitor. A way to calculate the flow about bodies of revolution is indicated. Digital computers are well suited to this method as no function tables are needed.

PA-59-8159

S-55. Smythe, W. R.

4360. **Electric and magnetic forces between sphere and wire.** W. R. SMYTHE. *J. Appl. Phys.*, 22, 521-2 (*April*, 1951).

Formulae are derived for the force and scalar potential of a dielectric sphere in the field of a charged wire and for the force and vector potential of a permeable sphere and a circular cylinder carrying current. When the sphere is conducting the electric force is $q^2a^2(\pi\epsilon_v b)^{-1}(b^2 - a^2)^{-\frac{1}{2}} \sin^{-1}(a/b)$ in M.K.S. units, where q is the charge per unit length on the wire, a the sphere radius and b the distance from its centre to the wire. The same formula, with i for q and μ_v^{-1} for ϵ_v, applies to a sphere of large permeability in the magnetic field of a circular cylinder carrying a current i.

PA-54-4360

S-56. Solov'yev, V. A.

Solov'yev, V. A.
A METHOD FOR THE MEASUREMENT OF CHARGES AND SIZES OF FOG DROPLETS (Ob Odnom Metode Izmereniya Zaryadov i Razmerov Kapel' Tumana) trans. by A. Pagell. 1960, 6p. 9 refs. NRL Trans. 795.
Order from OTS $0.50 60-21587

Trans. of mono. Mezhvedomstvennaya Konferentsiya po Voprosam Issledovaniya Oblakov, Osadkov i Grozovogo Elektrichestva (no. 5) held in 1956 in Leningrad, 1957, p. 170-172.

A method and apparatus are described for the measurement of charges and sizes of fog droplets, and data are presented which were obtained with the aid of such an apparatus. T4-85

S-57. Somolyai, J., and H. Schnitzler

Apparatus for continuous measurement of the charge on aerosols. Bergwerksverband G.m.b.H. (by Joseph Somolyai and H. Schnitzler). Ger. 1,112,845, (Cl. 42l). Appl. July 31, 1959.
CA-56-P974c

S-58. Soo, S. L.

"Effect of Electrification on the Dynamics of a Particulate System," Ind. and Eng. Chem., Fundamentals 3, No. 1, 75 (1964).

The significance of electrification on the dynamics of a gas-solid system was studied. At low temperatures, electrification of solid particles occurs because of impact with a wall. Basic considerations include motion of charged particles with spherical symmetry and axi-symmetry. It is shown that the pinch effect due to motion of particles charged to the same sign is insignificant. However, even a very slight charge on the solid particles will have a pronounced effect on concentration distribution in the flow of a gas-solid system.

Author

S-59. Soo, S. L., and R. C. Dimick

N63-16781 Illinois U., Urbana
EXPERIMENTAL STUDY OF THERMAL ELECTRIFICATION OF A GAS-SOLID SYSTEM
S. L. Soo and R. C. Dimick. Charlottesville, Va. U. School of Eng. and Applied Sci., Apr. 1963. 21 p. 6 refs. For Presentation at the Symp. on Multi-Component Multi-Phase Flows, Nov. 1963
(Contract Nonr-2623(00). Proj. Squid)
(SLL-11-P)

A preliminary experimental study was carried out on the thermal electrification of a gas solid system and removal of electrons from an ionized gas by charged solid particles

N63-16781

S-60. Soo, S. L., and R. C. Dimick

"Interaction of Solid Particles with an Ionized Gas," Preprint: Tenth Symposium (International) on Combustion, Cambridge, England (17 August to 21 August, 1964).

Consideration of equilibrium of ionization of a gas-solid suspension showed that the solid particles always became positively charged if the ionization of the gaseous atoms was negligible. However, the combination of high value of thermionic potential and low value of ionization potential of the gas may leave the solid particles negatively charged. Experiments with an arc flame of argon showed that addition of metals tended to increase the recombination rate while oxides tended to decrease the recombination rate of argon. Author

S-61. Spartakov, A. A., and N. A. Tolstoi

THE STABLE DIPOLE MOMENT OF PARTICLES OF AEROSOLS. [1961] 3p. 2 refs.
Order from OTS or SLA $1.10 61-16441

Trans. of *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki (USSR) 1955, v. 29, Sep., p. 385.

DESCRIPTORS: *Dipole moments, *Aerosols, *Particles, Smokes, Polarization, Light transmission, Tobacco, Test methods, Electrical properties, Optics, Photoelectric effect.

Light passing through a thickness of 3 to 5 cm of tobacco smoke was modulated by a field of electric rectangular impulses. The curve of the modulation indicated periodic diminution of the transparency of the medium. The effect was observed with any direction of polarization of the light. Each change of sign of the field led to a repetition of the modulation wave. The reorientation of the smoke particles that caused the modulation of the light is possible only if the smoke particle is polar, i.e., has a stable dipole moment.

T7-46

S-62. Sproull, W. T.

"Collecting High Resistivity Dusts and Fumes. Laboratory Performance of a Special Two-Stage Precipitator," Ind. and Eng. Chem. 47, 940 (1955).

S-63. Stäger, A.

2564. *Further Investigations on Contact Electrification for finely-divided Bodies, particularly Snow.* A. Stäger. (Ann. d. Physik, 77. 3. pp. 225-240, Aug., 1925.)—Experiments were continued at a high level near Berne on the electric charge per unit mass for rime, and for snow during light and heavy falls under different conditions of wind. Values are given, and the magnitude was found to increase with the wind speed and to differ if a change occurred in the kind of snow falling or in its amount. The small light particles carried a negative charge and the larger heavy particles a positive charge. The potential gradient over snow was mostly negative and seldom positive. Tests were also made on electrification produced by solid CO_2 and by sand. The results obtained were applied to explain the illumination often seen with a dust cloud and the electrification arising during falls of snow, hail and soft hail, and also partly that for the storms produced by heat and whirlwinds. Where precipitation also occurs in the liquid form other sources of electrification exist. [See also Abstract 1170 (1925).]
PA-28-2564

S-64. Stäger, A.

1170. *Experimental Investigations into Contact Electrification by Dust and Cloud-forming Powdered Substances, and especially with Snow as a Factor producing Storms.* A. Stäger. (Ann. d. Physik, 76. 1. pp. 49–70, Jan., 1925.)– A. Gockel's view that the whirling of snow, ice crystals, sleet and water-drops by squally air currents gave rise to storms with electrical disturbances was based on meteorological observations and statistics that such storms due to heat or whirls occur in conjunction with cirrus clouds. The author has carried out experiments with finely powdered substances such as sulphur, soot particles, flour, solid CO_2, and NH_4Cl to trace the origin of the large quantities of electricity in such storms. Rudge's results [Abstract 1573 (1914)] and similar results of Kähler, Beyersdorfer and Kercher were incorrect owing to electrification of the dust on their grating collector. The author arranged to avoid this source of error. Further tests were made with snow, sleet, and icicles partly on the Jungfraujoch, and it was established that snow becomes electrified when swept along by air currents with a greater charge per cubic metre with increasing wind strength. Of the charged particles the smaller possessed positive and the larger negative charges, the latter falling more rapidly in the air. The magnitude of the charge per cubic metre was on occasion as large as 50 E.S.U. The author concludes that since heat and wind vortices occur in the presence of cirrus clouds, it is probable that the electrification of snow and ice crystals contributes to the origin of electrical storms.

PA-28-1170

S-65. Stankiewicz, M. [illegible]

N64-12106* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FIELD EMISSION CHARGING OF METALLIC COLLOIDS
M Stankiewicz Washington, NASA, Dec 1963 27 p refs
(NASA TN D-2078) OTS: $0.75

With a free-electron model of metallic colloids, the charging time in an applied electric field is calculated for the alkali-group elements. A theoretical thin-wire ionizer is discussed with regard to required operating potentials, necessary geometrical dimensions, and current-density capabilities.

N64-12106, 03-23

S-66. Staszewski, W., and B. Adamczyk

2183. SPONTANEOUS ELECTRIFICATION OF DUST FIGURES IN A KUNDT'S TUBE. W.Staszewski and B.Adamczyk. J. Acoust. Soc. Amer., Vol. 30, No. 10, 987-9 (Oct., 1958).

Evidence is presented that in a Kundt's tube under suitable conditions spontaneous electrification of dust particles takes place. Appreciable time is needed for the particles to acquire a measurable charge, the sign of which depends on the material of the tube as well as that of the dust.

PA-62-2183

S-67. Stenzel, R. W., and W. F. Eberz

"Role of Electrostatic Precipitation in the Resolution of Industrial Emulsions," Am. Chem. Soc., Div. Petrol. Chem., Preprints 5, No. 3, 121-32 (1960).

S-68. Stenzl, J.

"Critical Voltage of DC Corona," Elektro. Obzor 34, No. 17-18, 254-5 (December 1945).

S-69. Stephenson, J. D.

"Electrical Discharge in Gases at Normal Pressures and Temperatures," Phil. Mag. (7) 15, 241-262 (1933).

S-70. Stern, S. C.; Steele, D. R., and O. E. A. Boldaum

"A Large-Volume Electrostatic Air Sampler," AMA Archives of Ind. Health 18, 30-33 (1958).

S-71. Straubel, H.

15113 THE STABILIZATION OF ELECTRICALLY CHARGED PARTICLES IN ALTERNATING FIELDS. H.Straubel. Acta phys. Austriaca, Vol. 13, No. 2-3, 265-73 (1960). In German.

Three thin cylinder rings were arranged on a vertical axis. One of the outer ones was positive and the other negative, and an a.c voltage was applied to the middle one. The equation of motion of a charged particle in the middle of the aperture of the middle ring obeys a Mathieu equation. When viscous damping was present, there was a stability region such that, for suitable ranges of e/m and the amplitude of the a.c. field, a particle could be stably at rest. For voltages exceeding the stability limit, or when e/m was altered, instability set in sharply. The arrangement could be used for a measurement of the e/m ratio or for studies of evaporation of oil drops, etc. The particle was illuminated and the scattered light observed by means of a photomultiplier. The photomultiplier current was proportional to the square of the particle radius. The apparatus could thus be calibrated for particle size. Absolute measurement of the particle mass was not possible.

PA-63-15113

S-72. Straubel, H.

Rate of evaporation and changes in the electrical charge of drops. Harald Straubel. *Duchamo Monograph.* 32, 153-6(1950).

CA-54-16033i

S-73. Straubel, H.

1186. MILLIKAN'S OIL DROP EXPERIMENT. H.Straubel. Naturwissenschaften, Vol. 42, No. 18, 506-7 (1955). In German.

A short note describing a modified version of the experiment in which motion of the charges is caused by a modulating electric field.

PA-59-1186

S-74. Straubel, H.

Straubel, Harold.
THE ELECTROSTATIC ATOMIZATION OF LIQUIDS.
Preliminary Report. [1962] 6p. (7 figs. omitted)
2 refs.
Order from SLA $1.10 62-16631

Trans. of Zeitschrift für Angewandte Physik (West Germany) 1954, v. 6, no. 6, p. 264-267.

DESCRIPTORS: *Electrostatics, *Atomization, Liquids, *Organic compounds, Electron microscopy

The properties of various organic liquids are discussed with regard to the best atomization. It is shown as to how the charged floating particles are applied to model experiments on the electron motion, either in the Braun's tube or in the electron microscope.

T8-662

S-75. Straubel, H.

8262. Electrostatic atomization of liquids. H. STRAUBEL. *Naturwissenschaften*, 40, *No.* 12, 337 (1953) *In German.*

A brief note describing experiments in which a liquid which would otherwise just not emerge from a small nozzle forms a fine spray on the application of a potential of 10-20 kV.

PA 56-8262

S-76. Stuetzen, O. M.

"Electrohydrodynamic Precipitator," Rev. Sci. Instr. 33, No. 11, 1171 (November 1962).

A contaminated fluid is charged and pumped into an electrodeless collection space, where particulates are precipitated. An approximate theory of precipitation is given; it is supported by experimental evidence. The method is especially suited for cleaning insulating liquids.

Author

S-77. Stuhlinger, E.

"Electric Propulsion 1964," Astronautics and Aeronautics 9, 26-30 (August 1964).

S-78. Suzuki, S., and M. Tomura

Suzuki, S. and Tomura, M.
STUDIES ON THE MEASUREMENT OF CHARGES ON FINE PARTICLES. PT. I. CHARGE MEASUREMENT OF TOBACCO AND MOSQUITO INCENSE AEROSOLS BY A CHARGE SPECTROMETER (1).
[1963] 9p.
Order from ATS $9.75 ATS-93Q69J

Trans. of Denshi Shashin (Japan) 1962, v. 4, no. 2, p. 20-24.

DESCRIPTORS: *Aerosols, Particles, Electric potential, Measurement, *Tobacco, *Smokes, *Insecticides, Culicidae, *Electrophotography, Photographic images, Distortion, Spectroscopy.

T10-1151

S-79. Suzuki, S., and M. Tomura

Suzuki, S. and Tomura, M.
STUDIES ON THE MEASUREMENT OF CHARGES ON FINE PARTICLES. PT. 3. CHARGE MEASUREMENTS OF TOBACCO AND MOSQUITO INCENSE AEROSOLS BY A CHARGE SPECTROMETER.
[Jan 64] 5p
Order from ATS $7.85 ATS-43Q73J

Trans. of Denshi Shashin (Japan) [1962] v. 4, no. 3, p. 18-20.

T11-805

S-80. Swann, H. W.

537.221 : 66/69

3433. Survey of harmful static electrification. H. W. SWANN. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 68–S 70 (1953).

A survey of the history of harmful static electrification in industry is given together with examples and various remedies considered.

PA-57-3433

S-81. Swann, W. F. G.

"Fundamentals in the Behavior of Electrets," J. Frank. Inst. 255, 513-530 (June 1953).

The paper cites certain results of an earlier paper [2] by the present writer in which are traced the consequences of the assumption that an electret is characterized by a state of polarization, semi-permanent in the sense that it decays very slowly with the time. The decay takes place under the influence of an ohmic conductivity.

The behavior of the dielectric in the case of an exponential decay is determined by the initial polarization P_0, which may vary across the electret, the initial potential difference V_0 between the surfaces of the electret, the coefficient, α, in the exponential decay, and the quantity RC representing the product of the resistance and capacity associated with the electret.

In the present paper it is demonstrated that, in the case of an electret which shows a maximum in the curve representing potential difference between surfaces plotted against time, all of the foregoing quantities may be obtained from measurements of the initial potential difference, the maximum potential difference, the time for the potential difference to fall to zero, and the time for it to attain its maximum. The theory of the matter is extended to the case where the semi-permanent polariza-

tion is represented by a finite or infinite number of contributions, each having its own particular relaxation time.

The paper discusses the question of what determines the initial potential difference after the electret is removed from its forming plates. It is shown that a reasonable understanding of the facts can be obtained qualitatively and quantitatively by assuming that on separating the plates slightly from the surfaces of the electret the charge densities retained by the plates are limited by the condition that the resulting field in the air space is less than the breakdown field in air, at the moment of separation.

Author

S-82. Szaynok, A.

10859 INFLUENCE OF IRRADIATION WITH β RAYS ON THE ELECTRIFICATION OF KCl CRYSTALS. A.Szaynok. J. appl. Phys., Vol. 31, No. 3, 451-3 (March, 1960).

The measurements of electrical charges on dust clouds of crushed KCl monocrystals previously irradiated with β-rays shows that the value of the mean charge depends on irradiation time. In the case of KCl irradiated with β-rays, a photoelectric effect is not observed, despite the presence of F centres.

PA-63-10859

T-1. Talwar, S.P. and S.S. Abbi

7206 ON THE CHANGE IN SHAPE OF A GRAVITATING FLUID SPHERE IN A UNIFORM EXTERNAL ELECTRIC FIELD. S.P.Talwar and S.S.Abbi.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 1, 7-12 (1956).

The stability of a conducting, gravitating, incompressible fluid sphere in a uniform external electric field is discussed by two different methods — the "energy method" and the "equilibrium method". The results obtained by both methods show that the stable configuration is a prolate of ellipticity,

$$\epsilon/R = \frac{5E^2R^4}{2GM^2}$$

PA-63-7206

T-2. Taneya, S.

8599 ELECTRIFICATION OF POWDER.
S. Taneya.
Japan. J. Appl. Phys., Vol. 2, No. 12, 798-804 (Dec. 1963).

The electrification of sprayed condensed skimmed-milk droplets is studied by observing the electrical potential inside the flow of droplets. Most droplets smaller than 100 μ in radius are charged positively, while larger ones are negatively charged. The electrification of dried skimmed-milk powder in pneumatic conveying is studied by the same method. The powder is positively charged, the amount of charge increasing with particle concentration in the flow and with the flow velocity. The amounts of charge on powder particles electrified in running in a V-shaped chute are determined by allowing the particles to fall down in an a.c. field and observing the sinusoidal tracks of the particles. For dried skimmed-milk, dried milk, dried butter milk, flour and powdered lactose, it is found that very small particles ($\approx 10\,\mu$ in radius) are mostly charged positively, the relative number of positively charged particles decreasing with the particle size. Particles $\geq 40\,\mu$ in radius are neutral. Such a big particle is in reality a composite particle consisting of a big particle and smaller ones.

PA-67-8599

T-3. Tauzin, P.

Photography of the trajectories of very small particles in suspension in air. Determination of the size, electric charge velocity of photophoresis, and density of the particles. Introduction and I. Apparatus. Pierre Tauzin. *Cahiers phys.* 19, 2-16(1944).

II. Interpretation of the plates obtained. Results. *Ibid.* 20, 25-57.

CA-37-3036[4]

T-4. Telford, J.W., N.S. Thorndike and E.G. Bowen
"The Coalescence Between Small Water Drops,"
Quart. J. Roy. Met. Soc. 81, 348 (1955).

T-5. Thomas, D.G.A.

537.221 : 545

3429. The measurement of oxidation of coal by static electrification. D. G. A. Thomas. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 55 (1953).

The electrostatic charge acquired by a stream of fine coal particles after making contact with a metal surface has been found to be related to the degree of oxidation of the coal. The effect forms the basis of an instrument for quality control in an oxidation plant.

PA-57-3429

T-6. Thompson, J.J.
"On the Electricity of Drops."
Phil. Mag. 37 (1894) p. 341

T-7. Thornton, W.M.
"The Electric Strength of Gases, Measured by Corona Discharge." Phil. Mag. (7) 28, 666-678 (1939).

T-8. Tietze, A.

3967. EXPERIMENTS ON THE ELECTROSTATIC CHARGING OF CO_2 SNOW. A.Tietze.
Z. Naturforsch., Vol. 12a, No. 1, 82 (Jan., 1958). In German.

T-9. Tilney, R.

3416. Electrostatic coating processes. R. TILNEY. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 51–S 55 (1953).

Describes the three methods of applying static electricity in the production of parts to which it is required to apply liquid coating. Development of these processes has led to their commercial application, in the first case by the introduction of particles of coating material atomized by compressed air into an electrostatic field; in the second case by the removal of surplus coating material from parts coated by dipping; in the third case by direct application of the coating material atomized and deposited by electrostatic force. The principles of these three processes are described and also mechanical and electrical arrangements for their application to commercial production. Finally some details are given of the types of production at present being handled and a summary of the results achieved by way of coating material savings. PA-57-3416

T-10. Tkach, V.K.

The precipitation of dust by using electrically charged water droplets. V. K. Tkach. *Voprosy Gigieny Truda i Profzabolev. v. Gornorud. Khim. i Mashinostroitel. Prom., Ukrain. Inst. Gigieny Truda i Profzabolev.* 26, 9–16 (1956).

CA-55-20534f

T-11. Tonks, L.

2651. Instability and Rupture of Droplets and Bubbles in Strong Electric Fields. L. Tonks. *Frank. Inst., J.* 221. *pp.* 613–620, *May*, 1936.—An approximate quantitative theory of the equilibrium of a bubble or droplet in a uniform electric field is developed and applied to earlier experimental results. An explanation of the oscillation of bubbles in strong fields and the difference in behaviour of positive and negative bubbles is explained on the basis of the discharge of electricity from points. [See also Abstract 3393 (1935).]

PA-39-2651

T-12. Trage, C.

174. Law of Charging of a Suspended Particle. C. Trage. *Ann. d. Physik*, 10. 7. *pp.* 833–845, *Aug.* 18, 1931.—The charge produced on a particle floating in an electrical field is partly due to ions which move along the lines of force to the particle, and partly to the thermal movements of the ions. The author has devised a method of investigating the process in which the spherical particle is replaced by a 4 μ Wollaston wire, stretched parallel to a straight wire at a high negative potential (3000 volts), placed in the axis of an earthed metal cylinder. In the final apparatus the high-potential wire was surrounded by a concentric cylinder of wire gauze, which separated it from the Wollaston wire. This obviated the difficulty due to electrical wind from the central wire. The theory of Deutsch predicted charges higher than those observed, while that of Arendt and Kallmann could be made to agree with measurements by making use of a suitable constant of integration. The value of this constant makes it probable that the undisturbed ionic density is brought by turbulence in the gas very near to the surface of the " particle."

PA-35-174

T-13. Trebitsch, H.

532. *Mobility of Solid Spheres of Radius not Less than* 10^{-5} *Cm. and their Electrical Charges.* H. Trebitsch. (Zeits. f. Physik, 30. 9. pp. 607–622, 1926.)—Particles of selenium were observed in a gas at various pressures when subjected to an electrical force equal and opposite to gravity. Assuming the law of mobility, B, *viz.*,

$$B = \frac{1}{6\pi\mu a}\left[1 + \frac{l}{a}(A + De^{-Ca/l})\right],$$

where μ is the coefficient of viscosity, a the radius of the particle, l the length of the mean free path of the gas particles, and A, D and C constants, the values of A, D and C were determined from 155 series of observations, and were: $A = 1{\cdot}034$, $D = 0{\cdot}172$, $C = 2{\cdot}773$. With these constants, the radii of the particles and their electrical charges were found. Some charges were notably smaller than that on the electron, *e.g.* $2{\cdot}80 \times 10^{-10}$ e.s.u., and those particles with the smallest charges gave values of A which were in best agreement with the common value. The significance of this is shown to lie in the uniformity of the densities of the separate particles. Also, as a general rule, small charges are associated with small radii. Further, the existence of electrons ought to entail, under specific conditions, equality in the values of e/A, where e is the charge on the particle, whereas the tabulated values of e/A vary between $2{\cdot}6$ and $6{\cdot}0$. PA-30-532

T-14. Tverskaya, N.P.

Collision and the merging of charged drops. N. P. Tverskaya. *Trudy Glavn. Geofiz. Observatorii* 1958, No. 73, 123–31; *Referat. Zhur., Geofiz.* 1958, Abstr. No. 8217.—An app. was described for the study of the exchange of charges between drops on their collision without fusion and of the effect of the magnitude of the drop charges on the transition of ineffective collisions to completely effective ones, i.e., leading to fusion. The collisions of charged drops, even without fusion, were accompanied by charge exchange. The collisions of charged particles, independent of the sign of the charges, led to the emergence of a neg. charge with relative magnitude which increased with a decrease in the charge of the upper drop. The effect of the charge on the effectiveness of the fusion is attributed to the formation of a double elec. layer on the drop which decreases the surface tension of the drop.

CA-53-12066b

T-15. Tukizi, O.

6192. The electric susceptibility of water drops due to ionic polarisation. O. TUKIZI. *J. Phys. Soc. Japan*, 6, 51–5 (*Jan.–Feb.*, 1951).

A new formula for the susceptibility of a water drop is developed in which account is taken of the ionic polarization within the drop. It is suggested that the analysis might provide a satisfactory explanation for tropospheric radiowave reflection.

PA-54-6192

T-16. Tunitskiy, N.

"Coagulation of Weakly Charged Aerosols," J. Phys. Chem. (USSR) 13, 1141-4 (1939).

T-17. Tunitskiy, N., et al

Charging of dust particles in an electrofilter. N. N. Tunitskii, M. V. Tikhomirov and I. V. Petryanov. *J. Tech. Phys.* (U. S. S. R.) 10, 1727-37(1940).—The theory of elec. charging of particles proposed by Pauthenier (*C. A.* 29, 55[9]) was applied to dust particles with triboelec. charges in the case when the accommodation coeff. of ions differs from unity. The expression for the time necessary for full recharging of dust, and for the lowest charge values of these particles which passed the electrofilter were obtained. The discharge process of marble-dust particles in an elec. field is in accord with the theory of Pauthenier. Dry coal particles lose their charge more slowly but the charging of marble and coal particles is very similar. PA-35-3540[8]

T-18. Tunitskiy, N., et al

Triboelectrical charges on dust particles. N. N. Tunitskii, M. V. Tikhomirov and I. V. Petryanov. *J. Tech. Phys.* (U. S. S. R.) 10, 1723-6(1940).—Triboelec. charges on small particles of coal, ash, Al and marble were measured by the method of N. Rosenbiyum (*C. A.* 32, 2405[9]). For ash, Al and marble dust the no. of particles bearing a pos. charge is practically equal to the no. bearing a neg. charge. In coal negatively charged particles predominated somewhat. The surface d. of elec. charge in an atm. of normal humidity was 5-15 elementary charges per l^2, where l is the mean distance between the particles. PA-35-3540[9]

T-19. Tunitskiy, N., et al

Particle discharge of an aerosol in a bipolar atmosphere. N. N. Tunitskii, V. Zarinskii and I. V. Petryanov. *Acta Physicochim U. R. S. S.* 13, 237-46(1940)(in German).—The particle discharge and that of the whole of a dil. aerosol in a bipolar-ion atm. proceed according to $Z_t = Z_0 e^{-\rho t}$, where Z_t and Z_0 are the charges, at 0° and t° and ρ is proportional to the ion concn. and independent of the radius. The Einstein-Fockter equations for the discharge and its fluctuations are derived. The exptl. data shown in 7 tables and 4 figs. on oleic acid fogs with $r = 0.15 - 0.18\ \mu$ and charged by a Ra prepn., agree well with the values calcd. from the derived equations. PA-35-2065[5]

V-1. Van Ostenburg, D.O. and D.J. Montgomery

3414. CHARGE TRANSFER UPON CONTACT BETWEEN METALS AND INSULATORS. D.O.Van Ostenburg and D.J.Montgomery. Textile res. J., Vol. 28, No. 1, 22-31 (Jan., 1958).

The equilibrium charge distribution between substances in contact is calculated in the one-dimensional approximation for metal—insulator and insulator—insulator contacts. The direction of charge transfer is such as to equalize the Fermi levels, and the magnitude of charge transferred depends on the positions of the energy bands in the substances in contact. For example, in an insulator it is possible to have a large density (~ 10^{20} esu) within a thin layer (~ 10^{-4} cm) of a small charge density (~ 10^{-1} esu) in a thick layer (~ 10^{-1} cm), to give the same contact potential drop (~ 1 eV), depending on the relative position of the bands. The energy levels in most insulators of high resistivities are too poorly known to allow strict quantitative comparison with experiment, but the results permit a semiquantitative explanation of some observations on static electrification.

PA-62-3414

V-2. Vedder, J.F.
"Charging and Acceleration of Micro particles"
Rev. Sci. Instr. 34, No. 11, 1175-1183 (1963).

Development work on charging and acceleration of microparticles gives promise of a micrometeoroid simulator capable of producing velocities well into the meteoric range. Velocities up to 7 km/sec have been attained with highly charged micron-size diamond particles with a 70-kV accelerating voltage. Single particles electrodynamically contained in a high vacuum are charged positively by an ion current to give charge-to-mass ratios approaching 400 C/kg. Once charged, the particle is extracted from the containing field and accelerated by a high potential. Preliminary work on charging microparticles of other materials demonstrates the possibility of producing high charge-to-mass ratios on many substances by this technique. Author

V-3. Vick, F.A.

3425. Theory of contact electrification. F. A. VICK. *Brit. J. appl. Phys. Suppl. No.* 2 [*Static electrification*] S 1–S 5 (1953).

After an outline of the relevant parts of the modern theory of solids, the transfer of electrons when metals, semiconductors and insulators are placed in contact is discussed. The importance of surface states is stressed. PA-57-3425

V-4. Vieweg, H.F.

2926. *Frictional Electricity.* H. F. Vieweg. (J. Phys. Chem. 30. pp. 865–889, July, 1926.)—The present investigation is undertaken with the following objects in view: (1) To arrange a frictional electric series of suitable materials; (2) to explain, if possible, from such a series how various factors determine the position a substance takes; (3) to learn what the effect of moisture is, and to what extent this may account for anomalies previously observed. A brief historical survey of the subject is given. Coehn's rule, which states that a frictional electric series of non-conductors from positive to negative corresponds to a series from highest to lowest dielectric constant, is considered. As a result of the study of the effect of moisture it is concluded that it is absolutely necessary to work in the absence of moisture if reproducible results are desired. Three curves showing the variation in charge on the gas with concentration of ionised HNO_3, $NaNO_3$, and NaHC are given. PA-29-2926

V-5. Vigdorchik, Ye. A.

Vigdorchik, Ye. A.
RETENTION OF AEROSOLS THROUGH BREATHING (Zaderzhka Aerozoley pri Dykhanii). 28 Oct 60, 127p. (59 figs., refs. omitted). Trans. V-1623.
Order from LC or SLA mi$6.30, pi$19.80 61-13805

Trans. of Nauchno-Issledovatel'skiy Institut Gigiyeny Truda i Professional'nykh Zabolevaniy. Trudy (USSR) 1948, v. 11, pt. 2, p. 39-67, 72-107, 130-131, 146-156, 159-170 and table of contents.

Contents:
Tabel of contents [of entire pt. 2]
Review of literature on this subject
Order of aerosol particles retained through breathing and visible in the microscope
Obtaining of aerosol concentration in a gas chambre
Determination of the number of aerosol particles in aerosol condensation in the industry
Retention through breathing of submicroscopical particles of aerosol condensation.

T5-228

V-6. Von Eichborn, J.L.

"Biological Effect of Unipolarly Charged Aerosols." "Koll. Zeit. 115, 169 (1949).

V-7. Vonnegut, B. and D.A. McCaig

"Single Electrometer Employing an Electrified Nonconducting Fiber." Rev. Sci. Instr. 28, 1097-8 (Dec. 1957).

V-8. Vonnegut, B. and C.B. Moore
"A Possible Effect of Lightning Discharge on Precipitation Formation Process," in "Physics of Precipitation" Geophysical Monograph No. 5, American Geophysical Union 1960, Publication No. 746.

V-9. Vonnegut, B. and R.L. Neubauer

5175. Production of monodisperse liquid particles by electrical atomization. B. VONNEGUT AND R. L. NEUBAUER. *J. Colloid Sci.*, 7, 616-22 (*Dec.*, 1952).

Streams of highly electrified uniform droplets about 0·1 mm in diameter can be produced by applying potentials of 5–10 kV a.c. or d.c. to liquids in small capillaries. Monodisperse aerosols having a particle radius of a micron or less can be formed if the capillary is positively charged and if liquids having low electrical conductivity are used. Aerosols formed in this way show the colours of higher-order Tyndall spectra.

PA 56-5175

V-10. Vonnegut, B. and R. L. Neubauer
"Detection and Measurement of Aerosol Particles."
Anal. Chem. 24, 1000 (June 1952).

V-11. Von Schweidler, E.
"On the Loss of Charge of a Sphere in Still and Moving Air." Sitzber. Akad., Wiss. Wein, Abt. IIa, 150, 209-19 (1941).

W-1. **Walker, E.A. and J.E. Coolidge**

2661 **Semiempirical Equation of Electrostatic Precipitation.** Eric A. Walker and John E. Coolidge. *Industrial and Engineering Chemistry*, v. 45, Nov. 1953, p. 2417-2422.

An equation for efficiency of precipitation is developed. Relates relative humidity, applied voltage, partical-size distribution, length of unit, and velocity. Photograph diagrams, tables, graphs. 6 ref.

BMI 3-2261

W-2. **Wall, C.N.**

2924. *Application of Elliptic Functions to the Method of Electrical Images.* **C. N. Wall.** (Tôhoku Math. J. 27. pp. 176–188, July, 1926.) —The problem of determining the distribution of electric potential due to a linear charge within an earthed conducting rectangular tube of infinite length has been treated by J. Kunz, P. L. Bayley and C. M. Hebbert [see Abstract 1126 (1921)]. The solution can be expressed concisely in terms of the sigma functions. A somewhat similar problem of determining the potential distribution around a linear charge between two coaxial circular tubes of infinite length and at zero potential has been solved by J. Kunz [see Abstract 1192 (1923)]. In both of these problems the solutions were obtained by the method of electrical images. In the present paper the second of these problems is generalised. It is shown (1) that the solution of this generalised problem can be expressed in terms of the theta functions or of sigma functions, (2) that the generalised problem is a simple transformation of the first problem noted above. As subsidiary results there appear functions with multiplicative periods, and also an interesting relation between the sigma functions and the theta functions.

PA-29-2924

110

W-3. **Wasser, E.**

792. Determination of the Error in the Ehrenhaft Method of Measuring the Smallest Charges on Single Test Particles. E. Wasser. *ZS. f. Phys.* **45. 7–8. *pp.* 561–567, 1927.**

The evacuation method, which has led to consistent values of the constants in the law of resistance of the medium to the motion of particles, has also brought out in the charges of the particles large deviations from the accepted electronic charge. In order to determine the experimental error of the method, new measurements were made with selenium particles of radial dimensions 10^{-5} to 3×10^{-5} cm. The whole question of the accuracy of the separate observations was then investigated, and it is shown that the deviations of the particle charges from the electronic value cannot be explained either by want of exactness in the measurements or by the manner of using the different resistance formulæ.

PA-31-792

W-4. **Webb, W.L. and R. Gunn**

9306. The net electrification of natural cloud droplets at the earth's surface. W. L. Webb and R. Gunn. *J. Meteorol.*, **12,** *No.* **3, 211–14 (*June*, 1955).**

Samples of more than 35 natural clouds passed through a special centrifuge and an ion filter in such a way that the free electricity on the droplets and on the air could be measured separately. The net charge on typical cloud droplets is less than one ion per droplet. This shows either that cloud droplets are not appreciably charged or that both positive and negative droplets are present and the distribution is such as to make the net charge very small. The measurements show that the capture of ions of a preferred sign by cloud droplets is not important.

PA-58-9306

W-5. Wells, W.F.
"Airborne Contagion and Air Hygiene."
Harvard University Press, Cambridge, Mass., 1955

W-6. West, G.D.

3839. Forces Acting on Drops in an Electric Field. G. D. West. *Phys. Soc., Proc.* **44.** *pp.* **336–341;** *Disc.*, **341–342,** *May* **1, 1932.**—**If whilst a drop of electrolyte is falling in distilled water, a horizontal electric field be established, the drop rapidly spreads out into a filament parallel to the lines of force. An explanation of this phenomenon is given on the basis of the charge at the boundary between conductors that necessarily accompanies the transport of electricity. Experiments with dielectrics and with drops that contract instead of expand are described, and the paper is illustrated with photographs.**

PA-35-3839

W-7. Weyl, W.A.

4944. **Surface structure of water and some of its physical and chemical manifestations.** W. A. Weyl. *J. Coll. Sci.*, 6, 389–405 (*Oct.*, 1951).

The difference in polarization of the positive and negative ions causes the more polarizable (i.e. the −) to be pushed towards the exterior and the less polarizable (the +) to withdraw slightly towards the interior, *in order to reduce the surface energy. The effect is* particularly marked in water because of the non-polarization of the H^+; the surface of the water droplet thus consists of a layer of O^{--} or OH^- ions followed by a layer of H^+, giving an electrical double layer; small droplets thus repel one another on collision (with large droplets the greater inertia overcomes the repulsive forces). There must be a transition from the "abnormal" atomic structure of the surface layer to the structure of ordinary water in the interior, and this requires a finite distance—perhaps some hundreds of atomic layers. Hence a water droplet must have a certain minimum size *S to* be stable, and *S will be a function of temp.* Essentially, then, ice is covered with a liquid film, which is in equilibrium with the ice. The significance of these conceptions for regelation, for the slipperiness of ice, for ballo- (waterfall-) electricity, for luminescence brought about by grinding (triboluminescence) and by ultrasonic vibrations (sonoluminescence), and also for the oxidation which occurs when water is exposed to strong ultrasonic radiation, is considered in some detail.

PA-55-4944

W-8. Whipple, F.J.W. and J.A. Chalmers

On Wilson's theory of the collection of charge by falling drops. WHIPPLE, F. J. W., AND CHALMERS, J. A. *Quart. J. Roy. Met. Soc.*, 70, *pp.* 103-118, *April*, 1944.—Wilson's theory of selective absorption of ions by drops of water falling in an electric field is developed mathematically in some detail, and trajectories are drawn for ions of different signs and velocities relative to the drop. The effect of turbulent flow is to modify the stream-line theory in some cases, the rate of charging being affected more than the final charge. The results obtained are in good agreement with such experimental work as has been carried out. The application to the production of thundercloud fields is complicated by the low conductivity produced by ion absorption on cloud particles, but tentative calculations show that the process may be of importance in the charging of raindrops below the cloud.

PA-48-2043

W-9. Whitby, K.T.
"Generator for Producing High Concentrations of Small Ions" Rev. Sci. Inst. 32 No. 12, 1351-1555 (Dec. 1961).

W-10. White, H.J.
"Modern Electrical Precipitation." Ind. Eng. Chem. 47, 932 (1355)

W-11. White, H.J.
"Effect of Fly Ash Characterists on Collector Performance." J. Air Poll. Conf. Assoc. 5, No. 1, 37 (1955).

W-12. White, H.J.
"Electrical Resistivity of Fly Ash."
Air Repair 3, No. 2, 79-87 (Nov. 1953).

W-13. White, H.J.
"Electrostatic Precipitator for Electric Generating Stations."
AIEE Winter General Meeting, New York, Jan. 19-23, 1953.

W-14. White, H.J.
"A Pulse Method for Supplying High-Voltage Power for Electrostatic Precipitation." AIEE Summer General Meeting, Minneapolis, June 23-27, 1952.

W-15. White, H.J.

1592 The Role of Corona Discharge in the Electrical Precipitation Process. H. J. White. *Electrical Engineering*, v. 71, Jan. 1952, p. 67-73.
Various aspects of the electrostatic process of cleaning smoke-laden air, with emphasis on the part played by the corona discharge, are discussed. 17 ref.

BMI 1-1592

W-16. White, H.J.
"Particle Charging in Electrostatic Precipitation."
AIEE Trans. 70, 1186 (1951)

W-17. White, H.J. and W.H. Cole
"Design and Performance Characteristics of High-Velocity, High-Efficiency Air Cleaning Precipitators." Air Poll. Cont. Assoc., Paper No. 59-48 (1959).

W-18. White, H.J., and G.W. Penney
"Electrical Precipitation Fundamentals" Engineering Proceedings P-39. The Pennsylvania State Univ., Univ. Park, Pa., July 1961.

W-19. White, H.J., C.M. Roberts, and C.W. Hedberg
"Electrostatic Collection of Fly Ash" Mech. Eng., 72, No. 11, 873-880 (Nov. 1950).

W-20. Whitman, V.E.

1486. *Electrification of Dust Clouds.* **V. E. Whitman.** (Phys. Rev. 28. pp. 1287–1301, Dec., 1926.)—Dust clouds were formed by blowing various pure chemical substances through tubes and the net electric charge imparted was determined as a function of the composition of the dust, tube material, area of contact between dust and tube during the blowing process, velocity with which the dust moved through the tube, and length of path of the dust through the tube. An apparatus is described with which photographic records of the paths of particles in an electric field were obtained. Such photographs show the presence of positive, negative, and neutral particles in all dust clouds, even of very pure substances. The ratio of positive to negative electrification in a cloud is found to change as the larger particles in the cloud settle out, but evidence is obtained which contradicts the hypothesis that the large particles carry an opposite charge from the small particles in a given cloud. The paper closes with a few remarks bearing on the relation of the present experimental data to the concept of a triboelectric series. PA-30-1486

W-21. Wigand, A.

1106. *Measuring the Electric Charges of Natural Mists.* **A. Wigand.** (Phys. Zeits. 27. pp. 803–808; Disc., 808, Dec. 1, 1926. Paper read before the Deut. Naturforscher u. Ärzte, Düsseldorf, 1926.)—That globules of a mist must carry high charges is shown, *e.g.*, by their great stability. The author and J. Wittenbecher measure the charges with the aid of a large condenser, charged to + 480 volts, the lower plate of which, 277 mm. in diameter, is covered with a removable sheet of filter-paper to catch the falling globules. The increase of weight of the paper is determined; the average radius of the globules (fairly constant) is deduced from diffraction observations, H. Köhler [Abstract 117 (1923)], and the number of globules (of the order 10^6) calculated from these data; an accuracy within 5 or 10 % is claimed for these estimates. The apparatus is encased in lead. Most mist clouds carry positive charges up to 1719 e.s.u. per globule in anticyclonic clouds; sometimes positive and negative layers occur together; in one case 2222 negative e.s.u. were observed. There is a relation between these charges and the potential gradient, but it is not clear. In the *Discussion*, **Seeliger** questioned the high values given.
PA-30-1106

W-22. Wigand, A. and E. Frankenberger

2749. Persistence and Co-Aggregation of Fog and Cloud. A. Wigand and E. Frankenberger. *Phys. Zeits.* 31. *pp.* 204–215, *March*, 1930.

The author considers first the magnitude and sign of the electric charge for fogs and finds that when persistent the drop charge is high, of the same sign and exceeds a certain limiting value. When the fog or cloud is thickening the drop charge is small, and below the limit and the sign variable. The effect of the electric double layer and Smoluchowski's views on these results are considered. A comparison is next made of Arendt and Kallmann's results with those of Wigand and Wittenbecher on the drop charge and the space charge in clouds. Smoluchowski's laws regarding the combination of drops are then applied to the cases of (1) diffusion and Brownian movements with air at rest and having stratification, and (2) turbulent or shearing motion in the air. This theory is applied to the experimental measurements of Wigand and Wittenbecher, and in a table are set out: (1) kind of fog, thickness and visibility; (2) notes on moisture; (3) wind velocity; (4) drop radius and charge; (5) limiting charges for thermal and turbulent motion. In some cases the drop charge prevents co-aggregation, but in others it assists. The results agree with Kohler's. Finally, the co-aggregation for uncharged rain clouds is considered according to Smoluchowski's formula for thermal and turbulent motion. [See Abstracts 1083 (1926) and 49 (1929).]
PA-33-2749

W-23. Wild, J.W. and J.D. Stranathan
"Influence of External Treatments on Electret Behavior" J. Chem. Phys. 27, No. 5, 1055 (Nov. 1957).

The following effects of external treatments upon electrets have been observed. (1) When the surface of an electret which exhibited a homocharge was planed in a lathe, the sign of the equivalent surface charge changed to that of the heterocharge. This heterocharge then decayed and the homocharge finally became dominant again. The magnitude of the final homocharge was smaller than that of a control electret which was not planed. (2) Repeated planing of an electret, with time allowed for recovery between successive planings, resulted in repetition of the cycle described in (1). (3) Wax dummies (not subjected to an electric field during manufacture) which were given a frictional charge and then planed, showed no reversal of sign; they did exhibit a small recovery after being planed. (4) Electrets subjected to 100% relative humidity exhibited an abrupt decrease in equivalent surface charge. Removal of the moisture resulted in a gradual, slight recovery. (5) The curve relating the equivalent surface charge and the logarithm of the pressure of the air surrounding an electret, has the same form as the curve of the sparking potential for air *versus* the logarithm of the pressure. Thus, all the treatments described resulted in a decay of the homocharge, followed by a partial recovery upon removal of the disturbing influence. The observed behavior can be explained in terms of the electret mechanism proposed by Gross. Author

W-24. Wilson, C.T.R. and G.I. Taylor

2331. *The Bursting of Soap-Bubbles in a Uniform Electric Field.* C. T. R. Wilson and G. I. Taylor. (Cambridge Phil. Soc., Proc. 22, pp. 728-730, July, 1925.)—Two circular metal plates were mounted horizontal and parallel; the lower one was wetted with soap solution and a measured soap-bubble was placed upon it, where it took a hemispherical shape. An adjustable difference of potential was established between the plates by means of an influence machine and a battery of Leyden jars in parallel. The bubble elongated as the field increased, becoming like the small end of an egg, and rapidly getting narrower at the end and then pointed as the field grew larger. At this stage the end vibrated with great rapidity, and photographs taken by means of a spark showed that filaments or drops were then thrown off from the end, one of the photographs shows an almost perfect cone. It is shown that the field which causes the bubble to become just unstable would, theoretically, be inversely proportional to the square root of the radius of the undistorted bubble, and this is confirmed by a series of measurements on bubbles with radii ranging from 0·251 to 1·062 cm. The authors conclude that the largest water drop that can exist in a field of 30,000 volts per cm., which is the greatest field without sparking in air at atmospheric pressure, has a radius of 0·02 cm.

PA-28-2351

W-25. Wilson, H.F., R.J. Janes and E.J. Campau
"Electrostatic Charge Effects Produced by Insecticidal Dusts." J. Econ. Entomol. 37, 651-5 (1944).

113

W-26. Winkel, A.

Electrical polarization of dust and its significance in electrofiltration. A. Winkel. *Z. Ver. deut. Ing. Verfahrenstech.* 1941, 25-8; *Chem. Zentr.* 1942, I, 2511.

CA-37-4018[5]

W-27. Woelflin, W.
"Electrical Coalescer Systems"
AICHE 55th Annual Meeting, Chicago, Dec. 2-6, 1962
Preprint No. 31.

The various types of electrical coalescer systems available to industry are described. These are applicable to emulsions and dispersions in which the continuous phase has a sufficiently high resistivity to sustain an appropriate voltage gradient without excessive current drains. Processes in which electrical coalescers can be used include the resolution of water-in-oil emulsions generally; the separation of acids and alkaline solutions from oils; the separation of the phases in many solvent extraction systems; the removal of liquid catalysts in alkylation procedures; and the removal of solids from oils by water-washing.

If the electric fields are properly designed and the chemistry of the system is appropriate, the powerful coalescing forces that can be brought to bear on the dispersed material can produce rapid and complete separation of the phases present.

Application of the equipment to oil field dehydration, crude oil desalting, distillate treating and other processes are discussed, giving size and equipment cost.

Author

W-28. Woessner, R.H. and R. Gunn

Measurements related to the fundamental processes of aerosol electrification. R. H. Woessner and Ross Gunn (U.S. Weather Bur., Washington, D.C.). *J. Colloid Sci.* 11, 69-76(1956);

With the object of illuminating the fundamental processes responsible for the electrification of aerosols, a number of measurements have been made to compare the initial distribution of charges carried by various aerosols with their final equilibrium state. Measurements have been made on freshly condensed water droplets and sulfur particles, on both freshly dispersed and aged silica dust particles, and on sprayed water droplets; all lying within the 1- to 2-μ radius range.

The measurements show that when numerous ions are formed within the aerosol space the particle charges are not completely discharged but rather the ions greatly hasten the attainment of an equilibrium distribution. Moreover, it is found that irrespective of the initial measured distribution of charges, the final equilibrium distribution approaches a Gaussian curve whose width is dependent upon the mean particle radius and is usually symmetrical about the axis of zero charge.

Because the infrequent collision of water droplets can hardly produce appreciable electrification by friction, and because the equilibrium charge on water droplets and that on silica particles of the same size are indistinguishable, it is concluded that the maintained charges on aerosols are a direct consequence of the diffusion of the ambient atmospheric ions onto the particles. The equilibrium distributions approach the theoretical form recently worked out by Ross Gunn.

Author

W-29. Wolf, L.

1617. Frictional Electricity. L. Wolf. *Ann. d. Physik*, I. 2. *pp.* 260-288, *Jan.* 19, 1929

An experimental study of the production of electricity by friction between metallic and insulating surfaces, under conditions which are made as definite as possible. Regular and reproducible results are obtained for the magnitudes of the charges developed, and for the effects of electric fields on the sign and magnitude of these charges. The results are discussed in terms of the "solution pressure" theory of electrification.

PA-32-1617

W-30. Wooding, E.R.

10839 Concentration Changes in an Aerosol. E. R. Wooding. *Physical Society, Proceedings*, v. 70, no. 445B, Jan. 1957, p. 65-70.

Coagulation rate when there is a potential barrier round the aerosol particles is calculated and two examples are considered.

BMI 6-10839

W-31. Workman, E.J. and S.E. Reynolds
"Structure and Electrification." in Byers, H.R. (Ed.) "Thunderstorm Electricity," Univ. of Chicago Press, Chicago, 1953, pp. 139-149.

W-32. Workman, E.J. and S.E. Reynolds

7250. Production of electric charges on water drops. E. J. WORKMAN AND S. E. REYNOLDS; E. W. B. GILL. Letters in *Nature* [*Lond.*] 169, 1108-9 (*June* 28, 1952).

The implication is refuted which is implied in a recent communication [Abstr. 3563 (1952)] that the potential differences accompanying the freezing of dilute aqueous solutions be interpreted as contact potentials. The effect of impurities on the sign of the resulting potential differences and the mechanism of charge separation during the freezing process are discussed.

PA-55-7250

W-33. Workman, E.J. and S.E. Reynolds

5802. Electrical phenomena occurring during the freezing of dilute aqueous solutions and their possible relationship to thunderstorm electricity. E. J. WORKMAN AND S. E. REYNOLDS. *Phys. Rev.*, 78, 254-9 (*May* 1, 1950).

The discovery of an electrical effect accompanying the orderly freezing of dilute aqueous solutions is reported. Potential differences as great as 230 V are measured across the water-ice interface during the freezing process. At a freezing rate of about 1 cm³ per min, a current of 1 μA is measured. The character of the effect is a function of the nature and concentration of the solute. The dependence of the effect on the structure of the ions of the solute and the molecular structure of water is shown. Possible application of this effect to chemical detection and to the formation of thunderstorm electricity is discussed.

PA-53-5802

W-34. Workman, E.J. and S.E. Reynolds

4316. A suggested mechanism for the generation of thunderstorm electricity. WORKMAN, E. J. AND REYNOLDS, S. E. Letter in *Phys. Rev.* 74, 709 (*Sept.* 15, 1948).—Preliminary tests on the potentials developed between the liquid and solid phases of water during a rapid freezing process indicate that contact potentials cannot be advanced as an explanation of the results obtained. Freezing of water in an earthed metal cup produces a potential difference as soon as a thin film of ice separates the water from the cup. The initial polarity is found to depend on the resistivity of the water, a reversal of polarity being sometimes observed as freezing approaches completion. Test results obtained on water drops impinging on cold ice are suggested to satisfy the requirements for the initial electrification in thunder clouds.

PA-52-4316

W-35. Wuerker, R.F., H. Sheldon and R.V. Langmuir
"Electrodynamic Containment of Charged Particles by Three-Phase Voltage."
J. Appl. Phys. 30, 441-2 (1959).

Y-1. Yadoff, M.O.

The physics of an electro-aerodynamic phenomenon. YADOFF, O. *Bull. Soc. Franç. Élect.*, 1, 443–57 (*Aug.–Oct.*, 1941) *In French.*—An insulated charged body will lose its charge at a rate dependent on the characteristics of the surrounding air. In stagnant air the rate is detectable but very small, while at an air velocity of 385 m/s the rate of loss of charge for a 35 mm diameter sphere becomes appreciable. A speed of 410 m/s can be considered as the limiting speed separating the barely detectable from the easily detectable rates. This speed corresponds to the value above which air cannot be considered to be incompressible. Probability theory leads to an exponential law for the rate of loss of charge and a gas coefficient is expressed in terms of humidity, absolute temperature, pressure and degree of ionization of the air. Irradiation with u.v. light increases the rate. A similar formula is deduced from Townsend's theory of ionization by collision. The physical system which develops is explained in terms of the movement of charges which, on the surface of a sphere, form an air condenser, as an oppositely charged layer forms on the outer surface of a stagnant air layer round the sphere. Movement of the surface charges and of the ions in the air are responsible for the discharge of the sphere. PA-49-1888

Y-2. Yoshikawa, H.H. et al

6999. ELECTROSTATIC PARTICLE SIZE ANALYZER. H.H.Yoshikawa, G.A.Swartz, J.T.MacWaters and W.L.Fite. Rev. sci. Instrum., Vol. 27, No. 6, 359-62 (June, 1956).

Comprises the theoretical analysis and physical description of an Electrostatic Particle Size Analyzer (EPSA) for determining the particle size distribution of aerosols in the 1 to 20 micron size range. Included are photographs and histograms illustrating the size separation attained and also a histogram of the particle size distribution in the general aerosol as determined by use of the instrument.

PA-59-6999

Z-1. Zebel, G.

Zebel, Günter.
ON THE THEORY OF COAGULATION OF ELECTRICALLY UNCHARGED AEROSOLS. [1958] 18p. 7 refs.
Order from SLA mi$2.40, ph$3.30 59-10948

Trans. of Kolloid-Zeitschrift (West Germany) 1958, v. 156, no. 2, p. 102-107.

The strong dependence of physical and chemical properties of an aerosol on particle size distribution is shown. With fine aerosols containing sufficiently large numbers of particles per square centimeter, the particle size distribution generally changes so quickly that an experimental measurement of the particle size distribution as a function of time is experimentally difficult. This result can be obtained by only one measurement with the help of the time rate of change of particle size distribution according to the theory of Smoluchowski. As an example, the complete calculation based on the solution of the resulting integral-differential equation was obtained by means of an electronic computer. T1-381

Z-2. Zebel, G.

Zebel, Günter
ON THE THEORY OF THE BEHAVIOR OF ELECTRICALLY CHARGED AEROSOLS. [1958] 39p. 10 refs.
Order from SLA mi$3.00, ph$6.30 59-10860

Koll. Zeits. 157, 37-50 (1958).

A basic theory is presented concerning the behavior of electrically-charged aerosols. The differential equation for the aggregation of electrically-charged aerosol particles is derived and solved. The transport of aerosol particles with electric charges in the electric field produced by the particles themselves is calculated. Combining these results gives an integral-differential equation for the changes of the particle size distribution of electro-aerosols. The following conclusions result from the theory. Two aerosol particles are to be considered as strongly charged if when they are in contact their electrostatic potential energy is large compared to the thermal energy kT. For strong charges of the same sign on particles the inhibition of coagulation depends exponentially on the product of the charges on the particles. For strong charges of opposite sign on particles the promotion of coagulation depends only proportionately on the product of the charges of the particles. If an aerosol is stabilized against coagulation by strong unipolar charges, then, in addition to the inhibition of coagulation, there arises a rarefaction of the aerosol because the aerosol particles endeavor to get away from one another due to electrostatic repulsion. For an aerosol with strongly unipolar charges, consisting only of particles of the same size and with the same charge, the rarefaction resulting from electrostatic repulsion is given exactly by a formal relation between the number of particles per cm^3 and the time. In a formal manner, but not in physical significance, this law agrees with the coagulation law of Smoluchowski (Z. phys. Chem. 92: 129-168, 1918). T2-39

Z-3. Zeleny, J.

3393. Electrical Discharges from Drops in Air. J. Zeleny. *Frank. Inst., J.* 219. *pp.* 659–675, *June*, 1935.—A study of previous work on discharges from charged attached drops and from uncharged drops falling in electric fields shows that the surface electric intensities at these drops, when the discharges begin, satisfy the theoretical relations for surface instability. Glow discharges, if initially present, are conditioned by the surface deformation arising from instability. Experiments are described that indicate that the highly charged droplets ejected by an alcohol surface may have mobilities not much below those of normal air ions while such droplets coming from a water surface may have mobilities even greater than those of air ions. Calculations, by Stokes' law, show such large mobilities for both kinds of drops to be possible. Further experiments show that under certain conditions the whole discharge current from an alcohol drop is carried solely by droplets of the liquid, resulting from surface instability, and under more restricted conditions the same may be true for a water drop. PA-38-3393

Z-4. Zeleny, J.

137. Variation with Temperature of the Electrification Produced in Air by the Disruption of Water Drops and Its Bearing on the Prevalence of Lightning. J. Zeleny. *Phys. Rev.* 44. *pp.* 837–842, *Nov.* 15, 1933.—The total charge carried by the negative ions which are produced in the air when a water drop is disrupted by falling through a horizontal stream of air was measured for different stream velocities at temperatures between 1° C. and 63° C. The dependence of this charge upon the size of the drop was found from observations made with drops differing in volume between 0·076 c.c. and 0·092 c.c. For blasts exceeding that necessary just to disrupt the drops, the charge obtained per drop disrupted increases rapidly both with the velocity of the blast and with increase of temperature. The rate at which the charge changes with increase of temperature of the drop depends upon the magnitude of the air stream employed for producing the disruption. For drops of 5·8 mm. diameter falling from a height of 8 cm. through a horizontal cylindrical stream of 1 cm. diameter and having an average velocity of 20 m./sec., the relation between the numbers of negative ions produced per drop disrupted at the temperatures 1·3° C., 24·2° C, 42·1° C and 62·5° C, respectively, was found to be 1 : 3 : 6·4 : 11. In the range of temperatures found in the atmosphere at different times the amount of electrification produced in the air when raindrops are disrupted by air currents of a given magnitude may be at least three times as large when the rain-water is warm as when it is cold. Rain temperature is therefore an important factor in determining the frequency and the intensity of lightning discharges. PA-37-[illegible]57

Z-5. Zeleny, J.
"Instability of Electrified Liquid Surfaces."
Phys. Rev. 10, 1-6 (July 1917).

Z-6. Zeleny, J.
"On the Conditions of Instability of Electrified Drops with Applications to the Electrical Discharge from Liquid Points." Proc. Cambr. Phil. Soc. 16, 71 (1915).

Z-7. Zoltoer, K.D.
"The Electrical and Mechanical Properties of Thin Liquid Films."
J. Tech. Phys. (USSR) 19, 1146-1153 (Oct. 1949).

SUPPLEMENTARY SURVEY

(Additional open literature references through May 31, 1965)

SA-1. Akazaki, M.

Corona Phenomena From Water Drops on Smooth Conductors Under High Direct Voltage.— The effect of high direct voltage on the formation and dislodging of water drops hanging from a smooth conductor is shown and used to explain the resulting corona characteristics, such as pulse amplitude and repetition rate, audible noise, radio influence and loss current, and corona current wave-forms. — M. Akazaki. *IEEE Transactions on Power Apparatus and Systems*, v. PAS-84, Jan. 1965, p. 1-8.

BMI 14-2476

SA-2. Amelin, A. G.

Amelin, A. G.
MISTS SERVE MAN. 20 Dec 61 [87]p. 15 refs.
JPRS: 11753.
Order from OTS or SLA $8.10 62-15353

Trans. of mono. Tumany Sluzhat Cheloveku, Moscow, 1961.

DESCRIPTORS: *Fog, Clouds, Artificial precipitation, Vapors, Condensation, Scientific research.

This book examines the basic properties of mists, the conditions of their formation and prevention, and examples are given of the utilization of mists in various fields of science and technology. T7-891

121

A general survey article written at an elementary technical level. The author indicates that charged insecticides can be deposited at over twice the rate of uncharged ones with even greater improvement in uniformity of surface covering but gives no details of data.

SRI

SB-1. Ballou, J. W.

"Static Electricity in Textiles." Text. Res. J. 24, 146-55 (1954).

SB-2. Bandel, H. W.

9504. Point-to-plane corona in dry air. H. W. BANDEL. *Phys. Rev.*, 84, 92-9 (*Oct.* 1, 1951).

A survey study has been made of point-to-plane corona in dried air for a range of pressures and point sizes. It has been found that negative points can be satisfactorily triggered by ultraviolet illumination and that the difficulties encountered in past attempts have probably been due to too intense illumination and possibly the presence of dust on the points. Under some conditions transitions from Trichel pulses to a pulseless Townsend-type discharge have been observed for negative points at high voltage. With positive points the occurrence of pre-onset streamers has been found to depend on higher pressures and the presence of water vapour to give sufficiently high photon absorption. Breakdown streamers are not observed with standard geometry for the usual points sizes, because the first one always closes the gap resulting in breakdown. For points of around 2 mm. dia. the gap must be about twice standard length with room air, and about two and one-half times standard length with dried air, for breakdown streamers to be observed.

PA 54-9504

SB-3. Bandel, H. W.

7915. Corona from ice points. H. W. BANDEL. Letter in *J. Appl. Phys.*, 22, 984-5 (*July*, 1951).

Ice points of 1 and 2 mm dia., mounted 8 cm from a plane, were used in corona studies. Threshold voltages, for corona onset, with +ve and −ve points and the corresponding current/voltage curves were determined. The effect of point conductivity on the nature of the discharges is described and the difference between −ve water and ice points is ascribed to relatively efficient photo-emission in the latter case.

PA 54-7915

SB-4. Barrett, P.

9231* Cathodic Atomization of Fused Electrolytes. (French.) Pierre Barret. *Comptes rendus*, v. 238, no. 10, Mar. 8, 1954, p. 1125-1127.

Compares phenomenon with atomization of dissolved electrolytes. 6 ref.

BMI 3-9231

SB-5. Barret, P.

"Superficial Mechanical Effects in Electrolysis Caused by Sparking." J. Chim. Phys. 49, C194-C198 (1952).

CA 46-5465

SB-6. Barret, P.

"Dispersion of Electrolytic Solutions by an Anodic Spark." J. Chim. Phys. 49, No. 7-8, C57-C63 (1952).

CA 47-5823i

SB-7. Barret, P.

"Measurement of Flame Temperatures." Pubs. sci. et tech., ministère air (France), Notes tech. No. 33, 42 pp. (1950).

CA 44-8184c

SB-8. Beach, R.

"Preventing Static-Electricity Fires. Parts I, II, III."
Chem Eng. 71, No. 26, 73-78 (Dec. 21, 1964)
ibid 72, No. 1, 63-66 (Jan. 4, 1965)
ibid 72, No. 3, 85-88 (Feb. 1, 1965)

SB-9. Beach, R.

"Electrostatic Neutralizer Discharge and Safety Characteristics." Elec. Engr. 71, 329-34 (April 1952).

Static electricity in industry is a menacing problem to production and personnel. Presented here is an evaluation of various types of static neutralizers with test data showing their comparative effectiveness to assist engineers in selecting suitable antistatic equipment.

Author

SB-10. Beischer, D.

911. Investigations on the strength of aerosol sediments. Orderly coagulation of aerosols. III. D. BEISCHER. *Kolloid Zschr.*, 89, pp. 214-219, Nov., 1939. *In German.*—[See Abstr. 3336 (1937)]. The author describes methods for determining by experiment the strength of threads formed of sediments of colloidal particles in a gaseous medium. The values thus obtained are compared with those calculated under the assumption of the exclusive presence of London and van der Waals forces. There is partly agreement between experimental and theoretical values. Where this is not the case it is assumed that either the particles are cemented together by surface diffusion or that they are under the influence of additional Coulomb forces. [See Abstr. 3955 (1936) and 1420 (1937).]

PA 44-911

SB-11. Bennette, C. J. et al

"Investigation of the Prebreakdown Gap Currents Between Clean and Cesium-Coated Tungsten Electrodes." AIAA Journal 3, No. 2, 284-90 (February 1965).

SB-12. Berghaus, H.

"Size and Charge Measurements of Inhalation Mists." Berichte a. d. Phys. Inst. der Universität Mainz, 1952.

SB-13. Blanchard, D. C.

"Electrostatic Field and Freezing." Science 133, 1672 (1961).

SB-14. Bonelli, L.

"Electric Phenomena on Aerosols." Z. Aerosol-Forsch. U. Therap. 2, 356-77 (1953).

SB-15. Böning, P.

"Theory of Charging Phenomena on Dust, Paper, and Spinning Material." Elektrotechn. Z. (Series A) 73, 655-8 (1952).

SB-16. Bowen, H. D., P. Hebblethwaite, and W. M. Carlton

"Application of Electrostatic Charging to the Deposition of Insecticides and Fungicides on Plant Surfaces." Agricultural Engr. 33, No. 6, 347-50 (June 1952).

SB-17. Bowen, H. D., W. E. Splinter, and W. M. Carlton

"Theoretical Implications of Electrical Fields on Deposition of Charged Particles." Trans. Am. Soc. Agri. Engrs. 7, No. 1, 75-82 (1964).

SB-18. Bricard, J.

"Combination Coefficients of Very Small Aerosols and Small Atmospheric Ions." Geofis. Pura e Appl. 51, No. 1, 237-42 (1962).

Summary — The idea of the mean free path of small ions is introduced in a theory previously published, and a value of the combination coefficients of these small ions on very small aerosols particles are evaluated. Theoretical results are discussed in comparison with experimental values.

Author

SB-19. Brown, R. E.

N65-10457] Aerojet-General Corp., Downey, Calif. Research Div
INVESTIGATION OF THE COALESCENCE OF WATER DROPS Summary Report
R E Brown 14 Aug. 1964 28 p refs
(Contract DA-36-039-AMC-03378(E))
(Rept.-0817-01(01)FP; AD-604747)

Laboratory studies of the coalescence of water drops after contact under conditions simulating or exaggerating those conceivably prevalent in the atmosphere and in clouds are reported. Efforts to find additives to the drops atmosphere and in clouds are reported. Efforts to find additives to the drops and to the air environment that would shorten the delay of coalescence were unsuccessful. However, the effects of ionizing radiation, drop environment, drop size, and collision velocity were investigated to evaluate the postulate that coalescence is promoted by a charge difference between the two colliding droplets. Theoretical analysis of the results qualitatively confirms the following. (1) The rate of coalescence increases directly as the square of the potential difference between the drops, under conditions in which the surface-tension pressure is negligible. (2) Coalescence time is inversely proportional to both surface tension and viscosity. (3) An increase in drop temperature enhances coalescence. (4) A sufficiently strong contact pressure or a fast relative velocity between otherwise stable drops often initiates coalescence.

N65-10457, 01-12

SB-20. Browning, K. A. and B. J. Mason

11401 PRODUCTION OF ICE CRYSTALS AND ELECTRIC CHARGE BY SPLINTERING OF FREEZING DROPLETS IN THUNDERCLOUDS. K.A.Browning and B.J.Mason. Quart. J. Roy. Meteorol. Soc. (GB), Vol. 89, 139-44 (Jan., 1963).

According to the Mason–Latham mechanism (Abstr. 20834, 20835 of 1961; 6912 of 1962) the main thunderstorm charge is generated by the impaction, freezing and splintering of supercooled droplets on pellets of soft hail. The rates of charge and splinter production are calculated using the Ludlam–Browning model of the thunderstorm. The riming mechanism appears capable of producing charge at the required rate of about 1 amp in the region of strong updraught if large cloud droplets of $r > 25\ \mu$ are present in concentrations of $\sim 10\ cm^{-3}$ near the 0°C level. Splintering of these droplets while freezing on pellets of soft hail would produce ice crystals in concentrations about one-tenth those of the large droplets between the −20°C and −30°C levels. The calculations indicate that the bulk of the thunderstorm charge cannot be generated and separated in regions of weak updraught because the production of splinters would lead to rapid glaciation of the cloud and the disappearance of supercooled water droplets.

PA 66-11401

SB-21. Brun, R. J., J. Levine and K. S. Kleinknecht

310. Brun, R. J., Levine, J., and Kleinknecht, K. S., An instrument employing a coronal discharge for the determination of droplet-size distribution in clouds, *Nat. adv. Comm. Aero. tech. Note* 2458, 53 pp., Sept. 1951.

Size distribution of droplets, in clouds above freezing temperatures, is measured by charging droplets in an electric field and allowing them to impinge on collecting cylinders of different diameter. The droplets are separated, according to mass, by flow around the larger cylinders. The charge deposited on each cylinder is a measure of the size distribution, when the collection efficiency is known.

A derivation is given of the electric field equation used and of the rate of acquisition of charge by water droplets. A flight instrument used to evaluate the method indicated required improvements in technique.

AMR 5-310

SB-22. Buehl, A.

LUEHL 1932

Wasserfall-Effekt und Oberflächenstruktur von Flüssigkeiten (Water-fall effect and surface structure of liquids). A. Buehl (Zuerich, Switzerland). Kolloid-Zschr., Vol. 59, No. 3, 1932, pp. 346–353, 6 fig., 3 tabl., 34 ref. (without titles).

Cited in LOEB 1945. Discusses: basic principles and experimental methods; sprays can be produced by (1) water-jet impact against solid obstacle, (2) bubbles through the liquid, which burst at the surface and produce droplets, and (3) air flow which aspirates the liquid from a container, as a perfume atomizer. Headings: seat of the electric double layer; order of magnitude of charge carriers; electrolytes; colloidal solutions; potential difference; gas adsorption; dipol momentum; mercury and amalgams. Refers to LENARD 1892 (electricity of waterfalls), and LENARD 1920.

de J. II-91

SB-23. Byutner, E. K. and F. A. Gisina

N64-20209 Joint Publications Research Service, Washington, D.C.

EFFECTIVE COEFFICIENT OF CAPTURE OF AEROSOL PARTICLES BY RAIN AND CLOUD DROPLETS

E. K. Byutner and F. A. Gisina *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 133–151 refs (See N64-20201 13-21) OTS: $5.00

Numerical evaluation is performed of the coefficients of capture of ash particles by cloud and rain droplets influenced by various mechanisms of capture. The effective coefficient of capture is computed for a given distribution of sizes of aerosol particles and water droplets. Different mechanisms of capture by clouds or rain predominate in different ranges of size of ash particles. The predominating capture of ash particles with radii ranging from 10^{-7} to $5 \cdot 10^{-5}$ cm is that due to electrostatic interaction of the particles and cloud droplets. For ash particles with radii ranging from $5 \cdot 10^{-5}$ to $2 \cdot 10^{-5}$ cm, capture is due mainly to electrostatic and polarization mechanisms, and for particles with radii ranging from $5 \cdot 10^{-5}$ to $2 \cdot 10^{-4}$ cm, capture is dominated by the polarization effect.

N64-20209, 13-21

SC-1. Cahn, J. W.

9432 STABILITY OF ELECTRICALLY CHARGED CONDUCTING DROPLETS. J.W.Cahn.
Phys. of Fluids (USA), Vol. 5, No. 12, 1662-3 (Dec., 1962).
Calculations are made to show that an electrically charged sphere becomes metastable when the ratio of electrostatic to surface energy is in excess of 0·7.

PA 66-9432

SC-2. Carson, R. S.

N65-12023# Illinois U., Urbana Charged Particle Research Lab
ELECTRICAL SPRAYING OF MACROSCOPIC LIQUID PARTICLES UNDER PULSED CONDITIONS
Ralph S Carson 15 Jan 1964 56 p refs
(Grants NSF G-19776; AF-AFOSR-107-63)
(AFOSR-64-1470; AD-604428)
It was found that glycerine, Octoil, and Octoil doped with tetra-n-butylammonium perrate readily spray from the end of a fine capillary, maintained at a high dc potential, in short periodic bursts that continue over a prolonged time interval of at least several hours. The dependence of the naturally pulsed spraying on applied voltage, on liquid constants and pressure, and on the geometry of the apparatus is determined by observing the spraying current; typical results are given. New techniques are presented for determining the specific-charge spectra of the droplets emitted in selected intervals during the spraying pulses by time-of-flight mass spectrometry, and for taking photomicrographs of the liquid surface at any instant before, during, and after the spraying pulses. A method for synchronizing the spraying to an external pulser is indicated.

N65-12023, 02-28

SC-3. Cho, A. Y. H.

"Contact Charging of Micron-Sized Particles in Intense Electric Fields."
J. App. Phys. 35, No. 9, 2561-4 (September 1964).

Micron-sized particles (0.3 to 15 μ in radius) of metals such as aluminum, carbonyl nickel, molybdenum; semiconductors such as magnetite and zirconium hydride; and insulators such as aluminum oxide, silicon oxide, and cenospheres are charged by contact electrification in electric fields up to 8000 V in a 0.3-cm gap. The charges are measured with a drift-tube detector and a quadrupole mass spectrometer and compared with a theoretical value which includes the contact potential and the electric field. Experimentally, the contact charge is quite important for particles less than one micron in radius, but relatively unimportant for larger particles. The experimental values are in good agreement with the calculated values for the range of materials and particle sizes studied.

Author

SC-4. Cochet, R.

"Lois de Charge des Fines Particules (submicronique) Etudes Théoretiques-Controles Récents Spectre de Particules." Colloque International - La Physique des Forces Electrostatiques et Leurs Applications (published by Centre National de la Recherche Scientifique, Paris, 1961).

Les lois de charge des particules submicroniques sont nécessaires à l'étude de leur comportement dans les électrofiltres et les appareils électriques d'analyse des aérosols. Nous proposons ici une correction à la loi classique de charge des particules microniques dans les champs électriques ionisés qui permet d'appliquer cette loi aux particules submicroniques.

La vérification expérimentale de cette théorie appliquée à des sphérules de gomme laque dont les rayons sont compris entre 0,02 et 0,5 micron et chargées dans des champs ionisés compris entre 1 500 V/cm et 5 000 V/cm donne des résultats intéressants. Nous avons mis en évidence un minimum de vitesse de précipitation pour les sphérules dont les rayons sont de l'ordre du dixième de micron.

Author

SC-5. Cochet, R.

"Calcul de l'Action des Aérosols Electrostatiques sur les Brouillards." Colloq. Intern. Centre Natl. Rech. Sci. (Paris) No. 102, 323-30 (1961).

Afin d'étudier l'action des aérosols électrostatiques sur les brouillards, nous avons d'abord utilisé différentes méthodes permettant de déterminer, soit par le calcul, soit graphiquement, le coefficient de captation γ d'une sphérule électrisée en tenant compte du champ créé par l'aérosol électrisé, puis exposé les méthodes de calcul permettant de suivre le grossissement de cette sphérule abandonnée dans un brouillard. La théorie générale de la captation a été vérifiée dans le cas particulier des cylindres et dans ce cas les trajectoires des gouttelettes de brouillard à proximité d'un conducteur cylindrique électriquement chargé ont pu être chronophotographiées.

Les calculs du coefficient de captation initial des sphérules solides électrisés montrent que les petites sphérules de l'ordre du micron ne sont utilisables que si elles sont plus fortement chargées que dans les conditions habituelles.

Author

SC-6. Coehn, A. and A. Curs

"Residual Electricity: The Potential of Metals Toward Dielectrics." Z. Physik 29, 186-95 (1924).

CA 19-604

SC-7. Coehn, A. and J. Franken

"Contact Electricity of Solid Dielectrics Against Conducting and Nonconducting Liquids."
Ann. Physik 48, 1005-33 (1915);
J. Chem. Soc. 110, II, 171 (1916).

CA 10-1960

SC-8. Coehn, A. and A. Lotz

"Contact Electricity in High Vacuum."
Z. Physik 5, 242-63 (1921).

CA 15-3585

SC-9. Coehn, A. and H. Mozer

"Contact Electricity of Gases in Relation to Conducting and Non-conducting Liquids."
Ann. Physik 43, 1048-78;
J. Chem. Soc. 106, II, 329-30

CA 8-3262

SC-10. Coehn, A. and V. Raydt

"The Quantitative Validity of the Law Concerning the Charging of Dielectrics."
Ann. Physik 30, 777-804

CA 5-1011

SC-11. Coenen, W.

"Recording Dust Measurements with Gas Ion-Deposition Techniques."
Staub 24, No. 9, 350-3 (1964).

CA 62-8681e

SC-12. Cohen, E.

N64-27961 Space Technology Labs., Redondo Beach, Calif.
RESEARCH ON CHARGED COLLOID GENERATION Final Report, Apr. 1963-Mar. 1964
E. Cohen Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 112 p
(Contract AF 33(657)-10999)
(APL-TDR-64-75; AD-601390)

The experimental research involved in the electrical-dispersion-of-liquids technique of generating a charged colloid beam is described. Charge-mass ratios were obtained by using a quadrupole focusing mass spectrometer during the single capillary tube stage of the work. When multiple needles were operated in parallel to increase the beam current, time-of-flight measurements replaced the quadrupole spectrometer. Data are presented both for the results obtained with single capillary tube operation and for the operation of many tubes in parallel.

N64-27961, 20-07

SC-13. Cooke, B. A.

8725. Charge acquired by powdered salts on moving over metal surfaces. B. A. COOKE. Letter in *Nature [London]* 176, 264 (Aug. 6, 1955).

Particles were allowed to slide down an earthed aluminium chute. The results showed that an adsorbed moisture film on the surface of particles of an ionic salt (e.g. NaCl) increased the amount of charge generated. For tiny glass spheres the converse was true. Also the charge on glass spheres covered by a moisture film, soon reached a limiting value when the amount of sliding was increased, but this was not evident for the ionic salts under the same conditions. The results for ionic salts contradict the common principle that appreciable electrification accompanies friction between two surfaces only if one or both of them has a low electrical conductivity. It is suggested that charge separation between an ionic salt and metal is mainly due to ion transfer whereas the electrification rule has been based on systems where electron transfer is predominant.

PA 58-8725

SC-14. Cooperman, P.

188. A NEW TECHNIQUE FOR THE MEASUREMENT OF CORONA FIELD STRENGTH AND CURRENT DENSITY IN ELECTRICAL PRECIPITATION. P.Cooperman. Trans Amer. Inst. Elect. Engrs I, Vol. 75, 64-7 (1956) + Commun. and Electronics, No. 23 (Mar 1, 1956).

A new probe method is developed by which steel balls are fired, through the discharge under investigation, into a Faraday cage in which the charge is determined by an electrometer. Test results are derived for a co-axial cylinder and for parallel wires between plates. The results obtained are critically examined. Conclusions are drawn on the distribution of the field strength and current density in electrical precipitators.

EA 60-188

SC-15. Culp, G.

N64-33819 Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering
AN INVESTIGATION OF THE POSSIBILITY OF ELECTRICALLY ATOMIZING VOLATILE LIQUIDS
Gary Culp (M S Thesis) Aug 1964 90p refs
(GSP/Phys 64-1, AD-603682)

Liquids studied included distilled water, ionically doped water (H_2SO_4 in H_2O) and liquid nitrogen. The liquids were forced under pressure through small metal capillary tubes held at high positive potentials with respect to a nearby ground plate. Liquid nitrogen was studied at atmospheric pressure and in vacuo, water was investigated only in vacuo. Particles sprayed from the capillary tubes were monitored with charged particle detectors to measure any net electrical charge. Resulting sprayed particles in all cases had net charge insufficient to be detected above background noise. The lack of charge on the sprayed particles can be explained by analysis of the key times required for ion separation in the liquid versus the time the ions spend in the electric field (a study of liquid velocity versus ion mobility)

N64-33819, 24-11

SC-16. Cunningham, R. G. and D. J. Montgomery

"Studies in the Static Electrification of Filaments." Textile Res. J. 28, No. 12, 971-9 (December 1958).

An apparatus has been constructed to rub filaments together under controlled mechanical and ambient conditions and to measure the charge remaining after separation. The apparatus is similar to that of Hersh and Montgomery, with refinements to obtain better control of mechanical variables and to allow variation of ambient pressure. A photomultiplier has been added near the filaments to detect the incidence of electrical breakdown of the atmosphere. Many of Hersh's findings for 45° 45° rubs have been confirmed, specifically those on reproducibility and triboelectric series. On the other hand, some findings have not been substantiated when the range of variables is extended. For nylon rubbed on polyethylene, the charge q shows a square-root dependence on the normal force F, in place of the linear dependence found by Hersh; the charge shows an inverse proportionality with diameter d, in contrast with the independence noted by Hersh. For tantalum rubbed on nylon, the charge is found to depend on a combination of velocity v, conductivity σ, and presumably dielectric constant ϵ, together with a characteristic distance l to be determined empirically. If the charge dependence on length of rub L is taken to be the proportionality found by Hersh, the combined relation

$$q = c(LF^{\frac{1}{2}}/d)(1 - e^{-\epsilon v/\sigma l})$$

is suggested, where the sign and the magnitude of c are in principle determined by the details of the band structure, but in practice are fixed experimentally. No detailed theoretical picture has been obtained to justify the rest of the expression, and it must be considered at present as an empirical relation whose generality and basis remain to be established.

Author

SD-1. Darmois, G.

"Cathodic Atomization of Electrolytic Solutions and Metals." Compt. rend. 79e congr. soc. Savantes Paris et depts., Sect. sci. Alger 1954, 17-20.

CA 51-11128c

SD-2. Davis, M. H.

N64-21300 RAND Corp., Santa Monica, Calif
ELECTROSTATIC FORCES AND CLOUD-DROPLET INTERACTION
M H Davis Mar 1964 11 p
(P-2885 AD-433239)

The purpose of this investigation was to study electrostatic effects on cloud-droplet trajectories, coalescence, and charging The case of droplet interactions in warm clouds where droplet radii are less than 25 microns was investigated Under these conditions, Hocking's solution to the hydrodynamic forces was found to be valid and was used The electrostatic forces were computed for separations greater than the radius of the larger drop by the "charge-and-dipole" approximation The assumption that cloud droplets can be treated as conducting spheres was critically examined and appears valid

N64-21300, 14-21

SD-3. Davis, M. H.

The Forces Between Conducting Spheres in a Uniform Electric Field. M. H. Davis (The Rand Corp., Santa Monica, Calif.). Project Rand Res. Mem. RM-2607, Jan. 26, 1961, 45 p., 12 fig., 3 tabl., 7 ref.

The electrostatic boundary value problem of two conducting spheres in a uniform electric field is solved in bispherical coordinates. The spheres may have any relative size, may be charged or uncharged, and the field may make any angle with their line of centers. Components of the force acting on one of the spheres along and perpendicular to the line of centers are derived, and numerical results are presented. Cites SARTOR 1954 and 1960, and SARTOR and DAVIS 1960. One important application is in the field of cloud physics, because electrostatic effects can influence the coalescence of cloud droplets; results are of interest in the physics of colloids. In the treatment the water droplets are considered conducting rather than dielectric spheres, and distortion of droplets when they are close together is neglected. Treatment is highly mathematical, involving potential function, Laplace's equation, Legendre polynomials. Results are presented in generalized form, and related coefficients are plotted as graphs.

de J II-124

Also available as ASTIA document No. AD 254 862.

SD-4. Deryagin, B. V.

14341 THE FORCE BETWEEN MOLECULES.
B. V. Derjaguin.
Sci. American, Vol. 203, No. 1, 47-53 (July, 1960).
A review article dealing with intermolecular forces and their electromagnetic origin.

PA 65-14341

SD-5. Deryagin, B. V., I. I. Abrikosova, and E. M. Lifshitz

Direct Measurement of Molecular Attraction Between Solids Separated by a Narrow Gap. B. V. Derjagin, I. I. Abrikosova, and E. M. Lifshitz (Lab. Surface Phenomena, Inst. Phys. Chem., USSR Acad. Sci., Moscow, USSR). Quart. Rev. Chem. Soc. (London), Vol. 10, No. 3, 1956, pp. 295—329, 15 fig., 2 tabl., 14 ref. (no titl.).

Cited in DERJAGIN 1960. Reviews previous and current theories (London, Casimir, and Polder, HAMAKER 1937) on existence and magnitude of molecular forces in objects of finite size. Discusses method of direct measurement of the molecular attraction of two solid bodies as a function of the gap separating them; applies the results to problems of surface phenomena and colloid chemistry. Describes and illustrates the beam-type microbalance with photoelectromagnetic negative feedback; used two quartz glass specimens, one plane and one spherical; gap between these was determined on basis of Newton's rings which were observed with a microscope. Discusses extreme care in cleaning the surfaces and eliminating spurious forces such as static electricity. Measurable range of force is from 2×10^{-4} to 20 dynes, and of gap widths 10^{-5} to 10^{-3} cm. Found that attraction between a spherical and a plane surface is proportional to the radius of the sphere. Results confirm existence of long-distance molecular surface forces; discusses application of findings to theory of coagulation (FUCHS 1934).

de J. II-129

SD-6. Deryagin, B. V. and S. S. Dukhin

Deryagin, B.V. and Dukhin, S.S.
SUR LE ROLE DE LA DIFFUSION DANS LES PHENOMENES ELECTROCINETIQUES. THEORIE DIFFUSIONNAIRE DE L'EFFET DORN, POTENTIEL DES PARTICULES EN MOUVEMENT. 8p. 4 refs.
CNRS-X 688.
Order from OTS, ETC or CNRS $1.10 TT-63-26430

Trans. in French of Akademiya Nauk SSSR. Doklady, 1959, v. 129, no. 6, p. 1328-1331.
Another trans. is available in English from CB $5.00.

T12-554

SD-7. Deryagin, B. V. and Ya. I. Rabinovich

"Experimental Verification of Thermophoresis Theory of Large Aerosol Particles." Dokl. Akad. Nauk SSSR 157, No. 1, 154-7 (1964).

CA 61-10080 g

SD-8. Deutsch, W.

"The Purification of Gases by Impulse Ionization." Zeits. Tech. Phys. 7, 623-30 (1926).

SD-9. Deutsch, W.

"Electrical Gas Purification." Zeits. Tech. Phys. 6, 423-37 (1925).

SD-10. Devir, S. E.

4717 ON THE COAGULATION OF AEROSOLS. I.
S. E. Devir.
J. Colloid Sci. (USA), Vol. 18, No. 8, 744-56 (Oct. 1963).
The coagulation of homogeneous slightly charged aerosol of dioctyl phthalate (DOP) was studied under essentially uniform experimental conditions. The experiments were carried out in a closed chamber (2½ m³) under "still" conditions. The decrease in number concentration of the aerosol in the chamber due to coagulation and deposition on the walls was measured for 5-6 hours. From the experimental data, the coagulation constant (K) and the deposition constant (g) were evaluated by the use of the equations and analytical method of Langstroth and Gillespie. A good agreement, within the accuracy of the measurements, was obtained between the experimental and theoretical values of K predicted from Smoluchowski's theory on coagulation.
PA 67-4717

SD-11. Dimick, R. C. and S. L. Soo

N64-33576 Illinois U., Urbana
THERMAL ELECTRIFICATION OF A CONDUCTING SPHERE
R C Dimick and S L Soo Aug 1964 11 p refs Submitted for Publication
(Contract Nonr-3623(00), Proj Squid)
(ILL-15 P, AD-445832)
Charging of a conducting sphere enclosed in a concentric vacuum by thermionic emission as limited by space charge was studied. A method of solution of the integral equation of the electric field is presented
N64-33576, 24-23

SD-12. Dimick, R. C. and S. L. Soo

N64-19637 Illinois U., Urbana
SCATTERING OF ELECTRONS AND IONS BY DUST PARTICLES IN A GAS
R C Dimick and S L Soo Charlottesville, Va U., School of Eng and Appl Sci., Mar 1964 14 p refs Submitted for Publication
(Contract Nonr-3623(00) Proj Squid)
(Tech Rept ILL-14-P, AD-433862)
Interaction of a partially ionized gas with dust particles was studied. Results show modification of an earlier approximation by Rosen with consistent degree of approximation
N64-19637, 12-24

SD-13. Dimmick, R. L.
"Jet Disperser for Compacted Powders in the 1-10 er Range."
Arch. Ind. Health 20, 8-14 (July 1959).

SD-14. Dinger, J. E., B. J. Mason and J. B. Matthews

23767 ELECTRIFICATION ACCOMPANYING MELTING OF ICE AND SNOW.
J. E. Dinger; B. J. Mason and J. B. Matthews.
Quart. J. Roy. Meteorol. Soc. (GB), Vol. 90, 206-9 (April 1964).
Dinger in this letter points out that the negative results obtained by Matthews and Mason (Abstr. 2203 of 1964) could be due to CO_2 "poisoning", to which Dinger and Gunn found this effect to be extremely sensitive. Mason and Matthews in a reply agree with this criticism and express the intention of experimenting with CO_2-free water.
PA 67-23767

SD-15. Dirnagl, K.

"A Summary Report on a Series of Measurements to Test an Electro-Aerosol Apparatus." Bericht a.d. Balneologisch en Inst. d. Universitat München, 1952.

SD-16. Dodd, E. E.

"Short Method for Evaluation of the Townsend Integral for Electron Avalanche Formation." Phys. Rev. 78, 620 (1950).

SD-17. Druett, H. A. and K. R. May

DRUETT and MAY 1954
Production of Individual Sized Droplets by High-Voltage "Firing" from a Micropipette. H. A. Druett and K. R. May (Microbiological Res. Dep., Min. of Supply, Porton, Wilts. Engl.). Nature, Vol. 174, Sept. 4, 1954, pp. 467--469, 2 ref.
Uniform size droplets can be produced: in the range below 10 microns with the LaMer vapor condensation apparatus, between 10 to 1000 micron by the spinning disc principle, 100 micron to several mm. by the vibrating tip, interrupted jet, and microburette principles, and 800 micron to 6 or 7 mm. by liquid falling by gravity from the tip of a vertical tube. Only the last method is suitable to produce individual drops, but only large ones. Developed method for producing individual drops, down to 10 micron size, by using a micropipette and applying a momentary high-voltage to the liquid. The technique, required pipette sizes, how to make them, and required voltages for each size pipette, are given in detail. Used the droplets for experiments on the evaporation rates of various airborne droplets, but suggest also other uses, such as combustion studies, application of insecticides to specific areas on insects, etc.
de J II-140

SD-18. Dukhin, S. S. and B. V. Deryagin

"Diffusion - Electrical Potential of a Falling Drop with an Adsorption Layer." Dokl. Akad. Nauk SSSR 121, 503- (1958).

CA 54-24112b

SD-19. Dunskii, V. D. and N. S. Smirnov

"The Effect of Ionizing Radiations on Aerosol Dispersion."
Kolloid Zhur. 21, 436--41 (1959).

CA 54-7288d

SE-1. Ehrenhaft, F.

"Development and Progress on the Question of the Size and Charge Determination of Individual Particles."
Phys. Zeits. 39, 673-87 (1938

SE-2. Eigen, M. and L. DeMaeyer

7738 SELF-DISSOCIATION AND PROTONIC CHARGE TRANSPORT IN WATER AND ICE.
M. Eigen and L. De Maeyer.
Proc. Roy. Soc. A. Vol. 247, 505-32 (Oct. 21, 1958).

A comprehensive survey on experimental techniques, results and theoretical interpretations concerning the self-dissociation and protonic charge transport in water and ice is given. Direct measurements of individual properties of "excess" and "defect" protons in ice (mobilities, concentrations, reaction rates) are presented. The proton transport in hydrogen-bonded media is completely different from normal ionic migration and corresponds more to electronic transport processes in semiconductors. Generally the proton transport through hydrogen bonds includes two processes: (1) the formation (or rearrangement) of (H-bond) structure with orientation, favorable for a proton transition; and (2) the charge transfer within the H bond. The first step is rate determining in water, whereas the second one is decisive for the charge transport in ice. The requirements for a theoretical treatment therefore are (1) for water: a theory of "structural diffusion" of the H-bonded hydration complex of H_3O^+, and (2) for ice: a (quantum-mechanical) theory of the protonic motion within the potential well of the H bond. The mechanism of structural diffusion provides an explanation of the anomalous H_3O^+ and OH^- mobility and their recombination rate in water. Arguments demonstrating the analogy between protonic and electronic charge transport are given.

PA 63-7738

SE-3. English, W. N.

Positive and negative point-to-plane corona in air. ENGLISH, W. N. *Phys. Rev.*, 74, 170-8 (*July* 15, 1943).—The present work has involved a careful comparison of positive and negative corona and observations at reduced pressures in the range 756 to 210 mm Hg. Oscillographic observation of corona pulses with a time resolution of the order of 10^{-7} sec, visual and photographic observation of the corona, and current-voltage measurements have thrown new light on fundamental corona processes. Some of the significant results obtained were as follows: For a polished Pt point of 0·38 mm diameter of curvature, the duration of positive pre-onset streamers and negative Trichel pulses near onset was ~0·4 μsec; for positive breakdown streamers, 0·8 μ sec. A comparison of positive and negative current-voltage characteristics showed that the intermittent onsets were approximately equal but showed a small pressure-dependent difference. Both curves showed linear Ohm's law regions, and the negative current was always the larger; these effects are due to space charge. The negative corona revealed the fluctuations and dependence on surface conditions noted by previous workers.

PA 51-2847

SE-4. English, W. N.

Corona from a water drop. ENGLISH, W. N. *Phys. Rev.*, 74, 179-89 (*July* 15, 1948).—Studies with a water drop point in a point-to-plane gap have yielded important results. Such a point has a very low secondary electron emission coefficient, and for the first time a large difference in positive and negative intermittent onset potentials in air, due to this, has been observed. The luminosity obtained with a negative drop point and the complex oscillograph pulses on both polarities have been accounted for by considering positive corona from charged droplets leaving the water point and assuming that true negative corona from a water surface is impossible. The space charge weakening of the field about a positive point, long assumed to explain the disappearance of the pre-onset streamers, is here confirmed by the reappearance of a stable drop point well above the initial potential required for disruption of the water surface.

PA 51-2848

SE-5. English, W. N. and L. B. Loeb

6216. Point-to-plane corona onsets. ENGLISH, W. N. AND LOEB, L. B. *J. Appl. Phys.*, 20, 707-11 (*July*, 1949).—The effect of point material and point radius of curvature on positive and negative intermittent corona onset potentials has been studied with a point-to-plane gap in air at atmospheric pressure. The negative Trichel pulse onset is independent of point material but does depend on point history and radius. This surprising result is shown to come from the circumstance that the Trichel pulse onset depends on current densities needed to condition the point surface and yield a higher value of the second Townsend coeff. to give the increased currents. Trichel pulse onset thus does not mark the onset of a self-sustaining discharge. The self-sustaining discharge initiates at lower potentials and leads to currents of a low order until the cathode spot cleans up.

PA 52-6216

SE-6. Evans, D. G. and W. C. A. Hutchinson

2202 THE ELECTRIFICATION OF FREEZING WATER DROPLETS AND OF COLLIDING ICE PARTICLES.
D. G. Evans and W. C. A. Hutchinson.
Quart. J. Roy. Meteorol. Soc. (GB), Vol. 89, 370-5 (July 1963).

When supercooled drops of diameter 1.3 mm were nucleated at −0.2°C and froze in an environment at −15°C and fragmented, the average charge on positive residues was 1.5×10^{-3} e.s.u., and on negative residues -2.2×10^{-3} e.s.u. The charges were comparable with those found in similar measurements by Mason and Maybank but were usually far too large to be accounted for by the Latham–Mason temperature-gradient theory. When ice crystals differing in temperature by up to 10°C were brought into momentary contact, any charge produced was less than 10^{-4} e.s.u. This result is not inconsistent with the Latham–Mason theory and does not confirm the much larger values reported by Reynolds et al.

PA 67-2202

SF-1. Favale, A.

N64-25993 Grumman Aircraft Engineering Corp., Bethpage, N Y Research Dept.
SOME ELECTRICAL CHARGING PROCESSES FOR VEHICLES IN SPACE AND POSSIBLE CONSEQUENCES
A Favale Jan 1964 8 p ref
(RN-176L)

This report illustrates quantitatively two types of charge accrual and discusses qualitatively some charge-loss phenomena. Two methods for producing electrical charges on vehicles are discussed—vehicle charging due to the earth's own surface charge and vehicle charging due to impingement of space radiation

N64 25993, 18-09

SF-2. Freier, G.

"The Coalescence of Water Drops in an Electric Field." J. Geophys. Res. 65, No. 12, 3979-85 (December 1960).

Abstract. Measurements have been made on large, freely falling drops interacting in a strong electric field. The measurements show definite coalescing effects due to the electric field, and the results can be interpreted as being due to induced dipole interactions. The effective radius of the drop can become 20 per cent greater than the geometrical drop radius when interactions take place in electric fields between 1 stat volt/cm and 10 stat volts/cm.

Author

SF-3. Freier, G. D.

20844 THE ELECTRIC FIELD OF A LARGE DUST DEVIL.
G.D. Freier.
J. geophys. Res. (USA), Vol. 65 No. 10, 3504 (Oct., 1960).

An electric-field mill recording of the electric field of a dust devil at a distance of 30 m shows that the field swings negatively and positively 430 V/m and 300 V/m respectively from the steady value of 160 V/m. It is suggested that an electric dipole of moment 1.7×10^9 e.s.u. cm at a height of 21.4 m will explain the main features of the recording, although the required velocity is then too low by a factor of 25.

PA 64-20844

SF-4. Frickel, R.

"Containment of Charged Particles."
Paper presented at 5th Coordination Seminar, CRDL, at IITRI, Chicago, Illinois, June 3, 1964.

SF-5. Fuchs, N. A.

"The Mechanics of Aerosols." The Pergamon Press, London, 408 pp., Dist. by Macmillan, New York, 1964.

SF-6. Fuchs, N. A.

3471. Stability and Charge of an Aerosol. N. Fuchs, *Zeits. f. Physik,* **89. 11–12.** *pp.* **736–745,** *July* **13, 1934.**—The application of Smoluchowski's coagulation theory to charged aerosols shows that a unipolar charge powerfully inhibits coagulation, while a bipolar charge acts much more feebly in the same sense. But if we take the rate of decay of the concentration of particles as our criterion of stability of an aerosol, the latter is greatly reduced by a unipolar charge in consequence of the electrical scattering of the particles.

PA 37-3471

SF-7. Fuchs, N. A. and I. Petryanov

31. Size and Charge of Cloud Particles. N. Fuchs and I. Petrianow. *Kolloid Zeits.* **65.** *pp.* **171–174,** *Nov.,* **1933.**—A photographic method is described for measuring the size, charge, and concentration of the droplets in a cloud in cases where the radius of the drops is above $0{\cdot}3\,\mu$. The method is applied to the determination of (1) the distribution of the drops of a condensed or dispersed oil cloud according to their size, and (2) the charges in a cloud charged by ultra-violet rays in relation to the sizes of the droplets.

PA 37-31

SG-1. Geist, J. M., J. L. York and G. G. Brown

9077. Electronic spray analyzer for electrically conducting particles. J. M. GEIST, J. L. YORK AND G. G. BROWN. *Industr. Engng Chem.*, 43, 1371-7 (*June*, 1951).

Analyses of sprays and other suspensions frequently involve sampling with microscope, slides, cells, or other relatively large devices, followed by tedious counting procedures. This paper presents some calculations to emphasize the advantage of small samplers and describes preliminary work in the development of an electronic analyser which utilizes a small sampler to measure and to count the particles. Metal spheres, with diameters from 500 to 6 340 microns, and drops of water, alcohol and acetone, with diameters from 2 500 to 4 500 microns, provide data to show that the electrical pulses created upon interception of the particles by the probe wire are proportional to the 1·6 power of the particle diameter. The effects of probe geometry and potential are shown, and the underlying mechanism is discussed. With further development of the geometry of the probe, the electronic spray analyser may offer an extremely rapid method for determining the drop size and size distribution in the spray of an operating nozzle, with a minimum sampling error. PA 54-9077

SG-2. Germer, L. H.

5753. ELECTRICAL BREAKDOWN BETWEEN CLOSE ELECTRODES IN AIR. L.H.Germer.
J. appl. Phys., Vol. 30, No. 1, 46-51 (Jan., 1959).

Prebreakdown electron current between electrodes closing at voltages below the minimum which can give breakdown by successive ionization of air molecules was measured by two different methods. This field emission current varies widely in successive experiments, increasing in general with decreasing voltage, with maximum values of the order of 10^{-7} amp. At the small electrode separations characteristic of breakdown at voltages below 300, it is shown that the ions necessary for breakdown come from the anode surface. The number of ions in the space at one time is so small that they cannot cooperate to enhance the gross field at the cathode, which is a conclusion having important consequences for the theory of breakdown.

PA 62-5753

SG-3. Gibson, E. G.

"Ionization Phenomena in a Gas-Particle Plasma." Ph.D. Thesis, Calif. Inst. of Technology, Pasadena, Calif., May 20, 1964.

SG-4. Gignoux, D., H. F. Anton, and J. J. Shea

N65-15876*# Cosmic, Inc., Washington, D.C.
DEVELOPMENT OF A CHARGED COLLOID SOURCE FOR ELECTROSTATIC PROPULSION Report No. 62
D. Gignoux, H. F. Anton, and J. J. Shea Oct 1964 78 p refs
(Contract NAS3-4106)
(NASA-CR-54176) OTS HC $3.00/MF $0.75

A large number of tests were performed with a rotating nozzle source of induction-charged colloid. The geometry was improved, resulting in an increase of the charge-to-mass ratio by one order of magnitude with respect to a previous program. Analytically, the ideal propellant was shown to have high viscosity, low density, low surface tension, low vapor pressure and high conductivity. The experimental values of the system parameters agreed conclusively with those predicted analytically. The search for a better propellant disclosed several promising avenues. Beam currents up to 1.5 milliamperes were obtained. The system has very promising application to high-efficiency electrostatic thrustors.

N65-15876, 06-28

SG-5. Gladkova, Ye. N. and G. L. Natanson

Methods of Measuring the Size of Monodisperse Fog Particles with a Radius of 0.1 to 0.5 microns (in Russian). Ye. N. Gladkova and G. L. Natanson (Inst. of Phys. and Chem., imeni L. Ya. Karpov, Moscow). Zhur. Fizicheskoy Khimii (USSR), Vol. 32, No. 5, 1958, pp. 1160–1162, 1 fig., 1 tabl., 5 ref. (Transl Joint Publ. Res. Serv., New York, No. L-648-N.)

Mean size of monodisperse fog particles can be determined by light diffusion (LaMER and SINCLAIR 1949), or by photographing the zigzag trajectories of charged particles in an electrical field (FUCHS and PETRYANOV 1933). Discusses the latter method, giving analytical derivations, describing experimental procedure, listing magnitude of charge on particles of a polydispersed aerosol. Refers to the Millikan experiment on the elementary charge. Lists some pertinent Soviet literature (PETRYANOV, LISOVSKIY and NATANSON 1948; FUCHS 1949). de J 11-1 N

SG-6. Glonti, G. A.

9289. ON THE THEORY OF THE STABILITY OF LIQUID JETS IN AN ELECTRIC FIELD. G.A.Glonti.
Zh. eksper. teor. Fiz., Vol. 34, No. 5, 1329-30 (May, 1958).
In Russian. English summary: PB 141052T-2, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The electrostatic field equation is combined with the general hydrodynamic equation for a viscous fluid, as is done in magnetohydrodynamics, to study the criteria for stability of a cylindrical jet of liquid dielectric in an electrostatic field. The effects of viscosity and direction of the field are examined as well as that of jet radius. Conditions for equilibrium at the surface are given.

PA 62-9289

SG-7. **Goyer, G. G.; J. E. McDonald, F. Baer, and R. R. Braham, Jr.**

"Effects of Electric Fields on Water Droplet Coalescence."
J. Meteorol. 17, 442-5 (August 1960).

Growth of incipient precipitation particles by collision and coalescence with cloud droplets is one of the primary mechanisms of natural rain. Comparison of previous research shows wide divergence between various theoretical and laboratory values of collision efficiency and coalescence efficiency. In an effort to obtain additional laboratory measurements of droplet coalescence, high-speed photographs were taken of colliding droplets at the breakup point in a Rayleigh jet. With 700-micron diam droplets, less than 30 per cent of the collisions result in coalescence under no field condition. At fields of about 40 v per cm, the coalescence was about 100 per cent under all conditions of field.

Author

SG-8. **Green, H. L. and W. R. Lane**

"Particulate Clouds: Dusts, Smokes, and Mists."
471 pp., Van Nostrand, Prinston, N. J., 1964.

SG-9. **Gudris, N. and L. Kulikowa**

384. *The Evaporation of Small Drops of Water.* N. Gudris and L. Kulikowa. (Zeits. f. Physik, 25. 2. pp. 121–132, 1924.)—The vapour pressure p_s on a convex surface is higher than that p_0 of saturated vapour on a flat surface of the same liquid. A drop of the liquid surrounded by saturated vapour therefore tends to evaporate. Calculations based on the theory of diffusion indicate that drops of water and mercury of radius about 10^{-4} to 10^{-5} cm. should be completely evaporated within a few seconds. Schidloff, Karpowicz, McKeehan, and Targonsky have found, however, that the radius of a drop decreases only by 10 to 30 % during a period of several hours; also the rate of evaporation decreases, whereas the pressure difference $p_s - p_0$ increases. The authors' investigation of the evaporation of drops of water in various gases shows that the rate of evaporation depends largely upon the absorption of the gas by the drops. This explains the observed progressive retardation of evaporation and the influence of the "age" of the drop. Observations of evaporation under different vapour pressures show that the rate of vaporisation of the drop does increase with the pressure difference $p_s - p_0$. Also, by reducing the vapour pressure on the drops, it is possible to delay their evaporation; and if the reduction is such that the vapour pressure on the drops is less than that on a flat surface, the drops increase in size instead of evaporating. The experimentally determined pressure on the drops in the state of equilibrium agrees with that calculated by Kelvin's law. The authors' observations show that the evaporation of drops of the size stated is, within the limits of accuracy of the experiment, affected neither by the magnitude nor the sign of their electrical charge.

PA 28-384

SG-10. Gudris, N. and L. Kulikowa

"Vaporization of Small Water Drops."
J. Russ. Phys. Chem. Soc., Physical Part 56, 167 (1924).

CA 19-3186

SG-11. Guyton, A. C.

"Electronic Counting and Size Determination of Particles in Aerosols."
J. Ind. Hyg. Toxicol. 28, 133-41 (1946).

CA 40-5606

SH-1. Hampe, P.

"Electrostatic Charging."
Rev. Viticulture 93, 256-61 (1947

SH-2. Harper, W. R.

"Electrification following the Contact of Solids."
Contemporary Physics 2, 345-59 (1961).

The charge found on solids after they have been rubbed together can only be a direct consequence of friction when the rubbing is vigorous; more usually, the charging is the result of contact, rubbing complicating the phenomenon. Opinions differ regarding the origin of contact charging, but certain experiments suggest a working hypothesis, according to which the charging is due to electron transfer when both materials are either semiconductors or metals, but to ions when insulators take part. Electron transfer is associated with the setting up of a contact potential. Ion transfer can be caused either by a potential difference, in which case the current flows with the e.m.f., or it can be caused by forces that are not electrical in nature, in which case the current flows against the potential difference generated by the 'mechanical transfer' of charge. Author

SH-3. Harper, W. R.

"Contact Electrification of Semiconductors."
Brit. J. App. Phys. 11, 324-31 (August 1960).

Recently published experimental findings on the electrification of rutile powder by sliding down a metal chute can be explained by an extension of the present author's theory of the separation electrification of metals. The mechanism of the electrification of insulators must, in most cases, be quite different. Author

SH-4. Hauer, F. W.

"Bewegung und Ladung Kleiner Teilchen im Ionisierten Elektrischen Feld."
Ann. d. Physik 61, 303 (1920).

SH-5. Hayes, J. (ed.)

N64-29522* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ASTRONAUTICS INFORMATION. ELECTRIC PROPULSION Literature Search No. 587
Judith Hayes, comp. Jun. 1964 120 p refs
(Contract NAS7-100)
(NASA-CR-58361; JPL-AI/LS-587) OTS: $9.60 ph

This literature search has been compiled to update and supplement a search entitled "Electrically Propelled Spacecraft and Associated Subjects" issued in May 1962. The annotated references are classified into five general categories: General, Electromagnetic, Electrostatic, Electrothermal, and Nuclear-Electric. Within each section, references are arranged in chronological order. An author index and corporate-source index are included.

N64-29522, 21-27

SH-6. Hendricks, C. D.

N64-19840 Illinois U., Urbana
CHARGED PARTICLE PROPULSION: A DOUBLE ENERGY-CONVERSION PROBLEM
Charles D. Hendricks *In* Argonne Natl. Lab. AMU ANL Conf. on Direct Energy Conversion, Nov. 4-5, 1963 Dec. 1963 p 89-99 (See N64-19826 12-01) OTS: $2.75

An electrically sprayed liquid-droplet source of heavy particles was investigated. The parameters that were found to affect the spraying process are flow rate, capillary diameter, spraying potential, conductivity, viscosity, temperature and surface temperature. Specific charge distributions are included for glycerine and carbon glycerine sprays and dibutyl phthalate spray.

N64-19840, 12-27

SH-7. Herman, J. R.

8339 On the **Electrical Properties of Blowing Snow.**— Average charge per particle is on the order of 10^{-13} coulomb, which is two to three orders of magnitude greater than that found on quietly falling or "squall" snowflakes. — John R. Herman. *Annales de Géophysique*, v. 20, no. 3, July-Sept. 1964, p. 235-241.

RMI 13-8339

SH-8. Hersh, S. P. and D. J. Montgomery

"Static Electrification of Filaments."
Text. Res. J. 25, No. 4, 279-95 (April 1955).

In order to study the generation of charge on fibrous materials, an apparatus was constructed in which a fiber is held fixed while a second is rubbed across it under controlled mechanical and ambient conditions. It was found that the reproducibility was usually within ± 5% when the same two fibers were rubbed repeatedly; that the charge generated was dependent on the manner in which the materials were rubbed, and that the magnitude of the charge generated was directly proportional to the length of material rubbed and to the normal force between the fibers (although in some cases a definite maximum value was reached), but was independent of the apparent area of contact between the fibers and of the tension on the fibers. The effects produced by changes in velocity are more complicated to describe. Charge transfer was found to be independent of velocity when insulators (except Teflon) were rubbed together. For metals on

insulators other than Teflon, the charge generated was found to increase linearly with velocity until a limiting value was reached, and then to remain constant. When Teflon and metals were rubbed together, the charge increased linearly with velocity without reaching a maximum. When Teflon was rubbed with insulators, the charge increased linearly with velocity in some cases but remained constant in others.

A study of the dependence of the sign and amount of charge transferred on the nature of the materials rubbed was undertaken, and a triboelectric series was established. For metals on insulators, the amount of charge generated was found to be related to the work function of the metal and the position of the insulator in the triboelectric series. For insulators rubbed on insulators, the amount of charge transferred appeared to be independent of the positions of the insulators in the series. Author

SH-9. Hertz, H.

"Uber die Berührung fester elastischer Körper."
J. F. Reine u. Ange. Math. 92, 156-71 (1882).

SH-10. Hicks, W. W. and J. C. Beckett

5569. THE CONTROL OF AIR IONIZATION AND ITS BIOLOGICAL EFFECTS. W.W.Hicks and J.C.Beckett.

Trans Amer. Inst. Elect. Engrs I, Vol. 76, 108-11 (1957) = Commun. and Electronics, No. 30 (May, 1957).

It has been established that ionized atmospheres have demonstrable effects on human beings as well as on animals. An explanation of these effects have been sought more recently at the cellular level, where results to date show significant changes. Investigation is proceeding on all levels for the purpose of clarifying results already observed and establishing dosage and other techniques which will make artificial ionization a valuable resource for human well-being.

PA 61-5569

SH-11. Hogan, J. J. and C. D. Hendricks

INVESTIGATION OF THE CHARGE-TO-MASS RATIO OF ELECTRICALLY SPRAYED LIQUID PARTICLES.
J. J. Hogan and C. D. Hendricks (Illinois, University, Dept. of Electrical Engineering, Urbana, Ill.).
AIAA Journal, vol. 3, Feb. 1965, p. 296-301. 13 refs.
Grant No. AF AFOSR 107-64; NSF Grant No. G 19776.

Analysis of the charge-to-mass ratios (specific charges) of particles generated by the electrical atomization process. The study involves the surface energy of the dispersed systems of particles, the effects of space charge on the source, and the effects of conductivity on the atomization process. Experimental data are presented in support of these theories. Further, a colloidal suspension in glycerine is experimentally shown to produce particles of high specific charge (400 coul/kg) when electrically dispersed under appropriate conditions.

A65-18496, 08-28

SH-12. Hopper, V. D. and T. H. Laby

2168. The electronic charge. V. D. HOPPER AND T. H. LABY. *Proc. Roy. Soc. A.*, 178, *pp.* 243–272, *July* 31, 1941.—The determination of e by a new oil-drop method in which the electric field is horizontal is described. The expression for e in terms of quantities measured is similar to that which applies to H. A. Wilson's method. The correction for the departure from Stokes's law is obtained from Millikan's relation. The oil drops used are larger than those used by previous experimenters, and their velocity of fall and the velocity in the direction of the electric field could be estimated with satisfactory accuracy. Assuming $\eta_{23} = 1\,830 \cdot 10^{-7}$ c.g.s. unit, the value of e obtained is $(4{\cdot}8020 \pm 0{\cdot}0013) \cdot 10^{-10}$ e.s.u. The probable error calculated by least squares is about 1/3 of that obtained by Millikan. The errors in the determination of η_{23} by the rotating-cylinder and the capillary-tube method are discussed and the final mean $\eta_{23} = (1\,830{\cdot}06 \pm 2{\cdot}5) \times 10^{-7}$ c.g.s. is derived. This contributes an error of 1 : 500 in e and is its major uncertainty by the oil-drop method. Recent determinations of the electronic charge by the X-ray method are analysed. The mean value of e by this method is $(4{\cdot}8044 \pm 0{\cdot}0007) \times 10^{-10}$ e.s.u., and this result differs from the mean of the determinations of Millikan and the authors $(4{\cdot}8007 \pm 0{\cdot}002) \times 10^{-10}$ e.s.u. by $0{\cdot}0037 \cdot 10^{-10}$ e.s.u., which is less than the error due to the viscosity of air. Assuming the X-ray value of e, the viscosity of air can be deduced and is found to be $(1\,830{\cdot}9 \pm 0{\cdot}5) \times 10^{-7}$ c.g.s. unit at 23°C.

PA 44-2168

SH-13. Horgan, J. D. and D. L. Edwards

16239 FORCES IN DIELECTRIC FLUIDS.
J.D.Horgan and D.L.Edwards.
J. appl. Phys. (USA), Vol. 32, No. 9, 1784 (Sept., 1961)

The paper concerns the fountain of dielectric liquid produced by a highly charged needle conductor immersed in the liquid. Experimental work has indicated that the effect is due to ionization of the liquid and is not a polarization effect as has been thought.

PA 64-16239

SH-14. Hurd, F. K. and J. C. Mullins

"Aerosol Size Distribution from Ion Mobility."
J. Colloid Sci. 17, No. 2, 91-100 (Feb., 1962).

SH-15. Hydro-Nitro Soc.

"Apparatus for the Improvement of Bioclimatic Condition of Room Air."
Swiss Patent, No. 257,893, (July 1, 1949).

CA 44-9088a

SK-1. Keily, D. P.

N64-30005 Massachusetts Inst of Tech., Cambridge
MEASUREMENT OF DROP SIZE DISTRIBUTION AND LIQUID WATER CONTENT IN NATURAL CLOUDS Final Report
D P Keily 15 Feb 1964 24 p refs
(Contract AF 19(628)-2591
(AFCRL-64-62 ... AD-604339)

Cloud drops striking a charged metal target are shown to produce an electric pulse whose shape indicates that the electric contact process is a succession of events probably but not certainly, including corona, arcing, and conduction. Nevertheless, the pulse amplitude is closely proportional to the droplet surface area

N64-30005, 21-21

SK-2. Kisliuk, P.

7087. ELECTRON EMISSION AT HIGH FIELDS DUE TO POSITIVE IONS. P.Kisliuk.
J. appl. Phys., Vol. 30, No. 1, 51-5 (Jan., 1959).

Two mechanisms were proposed to account for the observed large yield of secondary electrons in gaseous breakdown at high electric fields. In one of these a single ion in approaching the cathode surface creates a "pass" by decreasing the width of the potential barrier. In the other the increased overall field due to a large number of ions in the gap is supposed to account for the increased emission. The first effect is re-examined and appears to be effective in the observed breakdowns of extremely small gaps in air. It may also be effective in breakdown at high pressure and in liquid and solid dielectrics.

PA 62-7067

SK-3. Kittel, C.

"Introduction to Solid State Physics." 617 pp., John Wiley and Sons, N. Y., 1956

SK-4. Klinkenberg, A.

"Electric Charging of Poorly Conducting Liquids in Turbulent Flow." Chem. Ing. Tech. 36, 283-90 (1964). English Summary: Fire Res. Absts. and Revs. 6, No. 3, 233-5 (1964).

SK-5. Klumb, H.

KLUMB 1954

Neues Verfahren zur Erzeugung und zur meßtechnischen Definierung hochdisperser Aerosole (New method for the production and for the metrological definition of highly dispersed aerosols). Hans Klumb (Univ. Mainz). Schwebstofftechnische Arbeitstagung 1954. Publ. by Phys. Inst. Johannes-Gutenberg-Univ. Mainz, Germany), pp. 2—4, 2 fig.

Methods for producing highly dispersed aerosols: Electrostatic atomization; Atomization by compressed air; Centrifugal atomization; Chemical and thermal methods.

New method of measurement: deposition by centrifugal force on glass slides for ultramicroscopic evaluation (SCHWENDEMANN) on a transparent plastic film. Spectrum of size-distribution is directly visible; the method is termed: Aerosol-Spectrometry.

de J I-180

SK-6. Klumb, H. and A. Schütz

"Investigation of the Electric Charge on Aerosols." Z. Aerosol-Forsch. u. Therap. 6, 40-53 (1957).

Die zu einer Meßapparatur zur Bestimmung der künstlichen und natürlichen Aufladung notwendigen Geräte, wie Aerosolgenerator, Beladevorrichtungen (Koronaentladung) und eine neue Meßkammer werden beschrieben.

Mit dieser Anordnung wird die natürliche und künstliche Aufladung von Aerosolen bestimmt. Bei der künstlichen Aufladung wird die Abhängigkeit der Teilchenladung von Teilchengröße, Dielektrizitätskonstante und Ionenstrom ermittelt. Weiterhin werden einige Beobachtungen über den Einfluß der unipolaren Aufladungen auf aerokolloidale Systeme angegeben.

Die bisher vorliegende Literatur (1) zeigt, daß über die elektrische Aufladung von Aerosolen besonders über die Möglichkeit der künstlichen unipolaren Beladung relativ wenig Forschungsergebnisse vorliegen, obwohl die elektrische Beladung nicht ohne Einfluß auf die Stabilität des aerokolloiden Systems zu sein scheint. Mit dieser Arbeit soll ein Beitrag zu diesem Thema geliefert werden.

Author

SK-7. Klyarfel'd, B. N. (editor)

"Investigations into Electrical Discharges in Gases." Macmillan, New York, 1964.

CONTENTS

Author

SK-8. Kontaratos, A. N. and S. T. Demetriades

"Electrical Breakdown of Gases at Elevated Temperatures." Phys. Rev. 137, No. 6A, A1685-6 (March 15, 1965).

A recently developed analytical expression relating α/p with E/p (α is the Townsend ionization coefficient, E the applied field strength, p the pressure) is used in conjunction with an appropriate breakdown criterion to theoretically formulate the experimental Paschen's law. Variations of both temperature and pressure are considered in this derivation. Theoretical and experimental values of both αd (d is the length of the discharge gap) and the minimum breakdown voltage for air are in close agreement in the region of validity of the streamer theory, i.e., for $pd > 500$ mm Hg×cm.

Author

SK-9. Kornev, M. A. and V. M. Takchenko

"Measurement of Degree of Electrification of Aerosols." Vestn. Tekhn. i Ekon. Inform. Nauchn.-Issled. Inst. Tekhn.-Ekon Issled. Gos. Kom. Sov. Min. SSSR po Khim. 1962, No. 6, 52-3.

SK-10. Krasnogorskaya, N. V.

"Investigation of Electrification Processes of Cloud Particles and Precipitation." Bull. (Izv.) Acad. Sci. USSR, Geofiz. Ser., No. 1, 51-59 (1960).

A quantitative analysis of the possible mechanisms of charging of particles of clouds and of precipitation on the basis of an analysis of experimental data, obtained at the earth's surface and in the free atmosphere, is adduced. A comparison of the experimental data with the results of calculations demonstrates that not one of the known mechanisms of precipitation of ions onto the drops can explain the high observed values of raindrop charges. High charge values may be acquired by raindrops in a cloud by way of gravitational coagulation; in proportion to the fall of drops from a cloud earthward, their charges decrease owing to conductivity of the air.

Author

SK-11. Krohn, V. E., Jr.

"Glycerol Droplets for Electrostatic Propulsion." Paper presented at the American Rocket Society Electrostatic Propulsion Conference, Berkeley, Calif., March 14-16, 1962. ARS paper No. 2398-62.

Charged droplets of glycerol containing dissolved antimony trichloride have been produced with narrow distributions of charge-to-mass ratio centered as high as 470 coul/kg and without significant numbers of ions accompanying the droplets. The distribution centered at 470 coul/kg would have a specific impulse of 2000 sec if it were accelerated through 430,000 v.

Author

SK-12. Krohn, V. E., Jr.

"Liquid Metal Droplets for Heavy Particle Propulsion." Paper presented at the American Rocket Society Electrostatic Propulsion Conference, Monterey, Calif., Nov. 3-4, 1960. ARS paper No. 1375-60.

Charged droplets of liquid metal have been produced in sufficient quantity and with charge-to-mass ratios which are adequate for some propulsion applications. Unfortunately, a serious problem remains; namely, the production of large numbers of metal ions along with the droplets under all operating conditions which have been tried.

Author

SL-1. Ladenberg, R.

5195. Physical Phenomena of Electrical Gas Purification. Part III. R. Ladenburg. *Ann. d. Physik*, 14. 5. *pp.* 510–520, *Aug.* 15, 1932.—Discussion of the phenomena of electrical gas purification in cylindrical filters shows that suspended particles of dimensions above 10^{-6} cm. maintain, by their charge and the action of the electric field of the radial corona discharge, their size proportional to their velocity and serve to explain the effectiveness of the filter. Particles of dimensions below 10^{-6} cm. have velocities of only 1·4 to 3 cm./sec. and play only a subordinate part. The electric wind from the point of the emitting electrode to the collecting electrode imparts, under the conditions obtaining in the electro-filter, additional velocities of 20 to 60 cm./sec. to the gas and to the particles suspended in it, but this is reduced by axial streaming of the gas. The exponential formula given by Deutsch for the degree of purification of an electro-filter allows an estimate to be made of the radial velocity of the suspended particles from measurements with a filter of given length and radius and with a given axial gas velocity. [For Part II see Abstract 599 (1931).]

PA 35-5195

SL-2. Langer, G. and J. L. Radnik

7921 DEVELOPMENT AND PRELIMINARY TESTING DEVICE FOR ELECTROSTATIC CLASSIFICATION SUBMICRON AIRBORNE PARTICLES. G.Langer and J.L.Rad. .. *J. appl. Phys. (USA)*, Vol. 32, No. 5, 955-7 (May, 1961).

A practical apparatus was developed for electrostatic size classification of aerosol particles of 0.1 to a few microns in diameter. The aerosol, surrounding by a sheath of clean air, is charged by passing it closely over an intense positive discharge at high speed. It enters as a fine filament at 1 m/sec into an electrostatic field between parallel plates. Charging rates several times above those predicted by conventional theory permitted good resolution. A high natural charge on the aerosols had an adverse effect on classification. Various aerosols were examined, and results of practical significance were obtained. With salt aerosols, strong higher-order Tyndall spectra were observed from the classified deposit.

PA 64-7921

SL-3. Latham, J.

9079 THE MASS LOSS OF WATER DROPS FALLING IN ELECTRIC FIELDS. J. Latham.

Quart. J. Roy. Meteorol. Soc. (GB), Vol. 91, 87-90 (Jan. 1965).

Experiments showed that water drops of radius 0.191 cm falling for 0.2 seconds through a horizontal electric field were disrupted and lost mass if the field strength exceeded 9000 V cm^{-1}. As the field strength was increased above this critical value the mass loss increased rapidly and in a field of 11 500 V cm^{-1} the drop lost about 35 per cent of its mass; for higher values of field strength the mass loss increased more slowly. Experiments also showed that the magnitude of the mass loss was dependent upon the time of exposure of the drop to the field. For exposure times less than about 2×10^{-2} sec drops falling in a field of 11 250 V cm^{-1} lost no mass but as the exposure time was increased above this value the mass loss increased rapidly and for an exposure time of about 0.1 sec the mass loss was 25 per cent; for longer exposure times the mass loss increased more slowly. An assessment is made of the importance of this disruption process in modifying the concentration and size distribution of raindrops and cloud droplets inside a thundercloud.

PA 68-9079

SL-4. Latham, J.

10726 THE ELECTRIFICATION OF SNOWSTORMS AND SANDSTORMS. J. Latham.

Quart. J. Roy. Meteorol. Soc. (GB), Vol. 90, 91-5 (Jan. 1964).

An analysis is made of available observations on the electrical properties of natural and artificial snowstorms. An explanation for this electrification is given in terms of a theory of charge transfer associated with temperature gradients in ice, which has been shown earlier to provide a tenable theory of thunderstorm electrification. Further analysis shows that sandstorms exhibit similar electrical effects to those of snowstorms, and it is suggested that the temperature gradient effect may provide an explanation for sandstorm electrification.

PA 67-10726

SL-5. Latham, J.

21040 THE ELECTRIFICATION OF FROST DEPOSITS. J. Latham.

Quart. J. Roy. Meteorol. Soc. (GB), Vol. 89, 265-70 (April, 1963).

Experiments showed that the exposure of a frost deposit to an air-stream caused ice splinters to be blown away from the deposit. These splinters were negatively charged if the air-stream were warmer than the deposit, and positively charged if it were colder; if they were at the same temperature then no electrification was produced. In a typical experiment, with the frost deposit 10°C warmer than the air-stream, the average charge carried away on a frost splinter was 6×10^{-7} e.s.u. These results can be explained, in sign and magnitude, by the Latham–Mason theory of charge transfer associated with temperature gradients in ice; in the frost-electrification experiments a temperature gradient was produced down a frost needle owing to the difference in temperature between the air-stream and the frost deposit, thus causing the outer and inner tips of the needle to acquire equal and opposite charges. If the needle were then broken and blown off by the air-stream it would carry away a charge of one sign leaving that of the other sign on the frost deposit on which it had grown; the sign of the observed charging was in agreement with the theory. Putting into the temperature-gradient equations measured values of the dimensions of an ice splinter and the temperature difference between its ends it was possible to calculate the theoretical charge residing on the ends of an ice splinter; this value was found to be in good agreement with the measured average charge per splinter.

PA 66-21040

SL-6. Latham, J. and W. C. A. Hutchinson

23768 THE ELECTRIFICATION OF FREEZING WATER DROPS. J. Latham; W. C. A. Hutchinson.

Quart. J. Roy. Meteorol. Soc (GB), Vol. 90, 209-11 (April 1964).

Latham in this letter claims that if certain assumptions which he states briefly are adopted the results of Evans and Hutchinson (Abstr. 2202 of 1964) and Mason and Maybank (Abstr. 20832 of 1961) can be reconciled with the temperature gradient effect.

Hutchinson in his reply cannot accept that these assumptions are satisfactory to explain quantitatively the electrification.

PA 67-23768

SL-7. Levin, L. M.

"Research in the Physics of Roughly Dispersed Aerosols." Moscow, Izd-vo An SSSR, 1961, 266p. Book review available: OTS, U.S. Dept. of Commerce, SOV/5603. Lib. of Congress Number QC921.5.L4

SL-8. Lifshits, E. M.

5277. THE THEORY OF MOLECULAR ATTRACTIVE FORCES BETWEEN SOLIDS. E.M.Lifshits. Zh. éksper. teor. Fiz., Vol. 29, No. 1(7), 94-110 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 73-83 (Jan., 1956).

A macroscopic theory is developed for the interaction of bodies whose surfaces are brought within a small distance of one another. The interaction is considered to come about through the medium of the fluctuating electromagnetic field. The limiting cases of separations small and large compared with the wavelengths of the absorption bands of the solid are studied. Upon going to the limiting case of rarefied media, the van der Waals forces of interaction between individual atoms are obtained. The effect of temperature on the interaction of the bodies is considered. PA 59-5277

SL-9. Lifshitz, E. M.

"The Effect of Temperature on Attractive Molecular Forces between Solids." Akad. Nauk, Dokl. 100, No. 5, 879-81 (1955).

SL-10. Lindblad, N. R.

"Effects of Relative Humidity and Electric Charge on the Coalescence of Curved Water Surfaces." J. Coll. Sci. 19, 729-743 (1964).

SL-11. Loeb, L. B.

"A Tentative Explanation of the Electrical Field Effect on the Freezing of Supercooled Water Drops." J. Geophys. Res. 68, No. 15, 4475-6 (Aug. 1, 1963).

SL-12. Loeb, L. B.

1040. Recent developments in analysis of the mechanisms of positive and negative coronas in air. Loeb, L. B. *J. Appl. Phys.*, 19, 882–97 (*Oct.*, 1948).—The mechanism of the negative Trichel pulses in air at atmos. pressure is re-analysed in the light of recent data [Abstr. 2847–8 (1948)]. The building up of an intense positive space charge, providing an auto-accelerative ionizing mechanism, and the choking-off by neg. ion formation are outlined, also the effect of these and other factors on pulse duration and frequency. The differences in pos. and neg. corona currents are investigated, and the character of the pos. corona mechanism analysed on the same basis as the neg. The pos. point removes electrons quite effectively, leaving a field distorted by one sign of space charge only, and thus less complicated; the volume sensitive to triggering electrons is much larger. The observed near equality of pos. and neg. pulse thresholds is shown to be fortuitous.

PA 52-1040

SL-13. Loeb, L. B.

The threshold for the positive pre-onset burst pulse corona and the production of ionizing photons in air at atmospheric pressure. Loeb, L. B. *Phys. Rev.*, 73, 798–800 (*April* 1, 1948).—Describes briefly the various forms of corona discharge and their connection with Geiger counter discharges. The burst pulse onset voltage in a particular experiment was consistent with a photon absorption coefficient lying, reasonably, between 10 and 100 cm^{-1}.

PA 51-2130

SL-14. Loeb, L. B.

2169. Electrical Breakdown of Gases at Atmospheric Pressures. L. B. Loeb. *Frank. Inst., J.* **205.** *pp.* **305–321,** *March,* **1928.**

After a brief summary and discussion of Townsend's theory of the electrical breakdown of gases in the light of certain recent criticisms, it is shown that these are compatible with his theory except for one serious discrepancy. This discrepancy lies in the fact that at the assumed fields at which breakdown occurs in air, at atmospheric pressure, and in inert gases at low pressures, the β/p of Townsend's theory cannot have the significance given it by Townsend, as the positive ions are incapable at these fields of acquiring the ionising energy. Various solutions proposed are discussed and found inadequate. It seems necessary, in order to keep this otherwise successful theory, to doubt the validity of the assumption generally made for plane parallel electrodes that the potential drop between the plates is uniform before the spark passes. If fields about ten times as great as those calculated from the uniform drop existed, the theory could be applied. It is shown that such fields are possible under the conditions of the spark potential experiments, due to space charges resulting from the difference of ionic and electronic velocities. The existence of such fields requires a finite spark-lag interval of about 10^{-4} second, as yet not definitely observed.

PA 31-2169

SL-15. Loeb, L. B., J. H. Parker, E. E. Dodd and W. N. English

"The Choice of Suitable Gap Formations for the Study of Corona Breakdown and the Field Along the Axis of a Hemispherically Capped Cylindrical Point-to-Plane Gap."
Rev. Sci. Inst. 21, 42-47 (1950).

The various corona gap forms suitable for the convenient investigation of corona phenomena of both signs in the laboratory that are capable of yielding quantitative data involving the Townsend integral for the thresholds of the manifold phenomena are discussed. For laboratory study the most convenient form of gap is the hemispherically capped cylindrical point-to-plane system. Analysis of the potential fall along the axis in such gaps by means of electrolytic model studies indicates that the essential parameter is L/r, the ratio of gap length, L, from point surface to plane relative to the point radius, r. The model study potentials are, however, incapable of giving accurate values of the field strength. These fields must be obtained by computation. Laboratory studies of corona indicate the desirability of relatively large values of L/r. Practical considerations based on studies at atmospheric pressure indicate point radii r of 0.025 and 0.05 cm with a ratio $L/r = 160$ to be those giving the greatest flexibility and most widely separated thresholds at convenient potentials. The use of such point systems to standardize data is recommended. On this basis the field along the axis for the hemispherically capped cylindrical point-to-plane gap as computed by E. E. Dodd is given and here applied to the calculation of the point-to-plane Townsend integral for pre-onset burst pulse thresholds in air as observed by H. W. Bandel. The value is compared with the values obtained by W. N. English for confocal paraboloids where the fields are accurately known. The results are satisfactorily consistent. Discrepancies in the fixing of burst pulse thresholds by various observers are discussed.

Author

SL-16. Loeb, L. B. and R. A. Wijsman

4000. The theoretical criterion for streamer advance in an electrical field. Loeb, L. B. and Wijsman, R. A.

Letter in *J. Appl. Phys.*, **19**, 797–9 (*Aug.*, 1948).—An extension of previous work on sparking equations for the higher pressure regions [Abstr. 2130 (1948)] which were based on the assumption that the streamer advance proceeds by avalanches built up from single photoelectrons ahead of the advancing streamer. The present work deals with advance due to several simultaneous avalanches, and the final sparking equation involves, besides Townsend's α, etc., photo-ionization cross-sections, and the number of photons produced for each positive ion in the streamer tip. A trial-and-error method of solving the equation is described.

PA 52-4000

SL-17. Lupinski, J. H. and K. D. Kopple

"Electroconductive Polymers."
Science 146, 1038-9 (Nov. 20, 1964).

Abstract. *Polymers of a new type with an unusual combination of properties have been synthesized. They are of high molecular weight, they are soluble in organic solvents, and they can be cast as films. Their electrical conduction is electronic in the solid state and can be controlled up to a conductivity of 10^{-8} ohm^{-1} cm^{-1}.*

Author

SM-1. Makhotkin, L. G. and V. A. Solov'yev

"The Electric Charges on Fog and Cloud Droplets." Trudy. Glavnaia Geofizicheskaia Observatoriia (Leningrad) No. 97, 1960.

SM-2. Matthews, J. B. and B. J. Mason

"Electrification Produced by the Rupture of Large Water Drops in an Electric Field." Quart. J. Roy. Met. Soc. (GB) 90, No. 10, 275-86 (October 1964).

SM-3. Matthews, J. B. and B. J. Mason

2203 ELECTRIFICATION ACCOMPANYING MELTING OF ICE AND SNOW. J. B. Matthews and B. J. Mason. Quart. J. Roy. Meteorol. Soc. (GB), Vol. 89, 376-80 (July 1963).

Attempts to measure the electrification produced by the melting of ice and snow, known as the Dinger–Gunn effect, have been made with three different experimental arrangements. In one of these snow crystals were grown and melted under very clean conditions inside a diffusion cloud chamber. The results of the three experiments are consistent in failing to detect a separation of charge and in indicating that any charge produced was $<10^{-2}$ e.s.u./g or two orders of magnitude smaller than reported by Dinger and Gunn. This result was unaffected by varying the purity of the ice, its air content and the rates of freezing and melting, and the pH value of the water. Accordingly, it is concluded that charging associated with the melting of snow or hail is unlikely to be an important feature in the electrification of clouds and precipitation.

PA 67-2203

SM-4. Matting, A.

"Color Spraying by Electrostatic Principles." Zeits. Ver: Deutscher Ing.

SM-5. Menes, M. and L. H. Fisher

5647. Positive point-to-plane corona studies in air. M. Menes and L. H. Fisher. *Phys. Rev.*, 94, 1-6 (*April* 1, 1954).

Formative time lags for the development of the positive point-to-plane corona in dry air were measured oscillographically at pressures ranging from atmospheric to a few centimetres of Hg. Studies with a photomultiplier tube show that the observed formative lags are associated with a filamentary streamer type of corona. These corona formative lags are of the order of 10^{-7} sec even near threshold and vary much more slowly with overvoltage than do uniform field formative lags in air. The results indicate that no long build-up process is associated with the formation of the filamentary streamer type of corona in air, and in particular rule out any cathode secondary mechanism from playing a role in the formation. Near atmospheric pressure, with the experimental conditions used, the corona formative time lags were often too short to be resolved from the statistical scatter; when resolvable they were found to be too long to be ascribed solely to a single transit time of the initiating electron avalanche across the high field region of the gap. The results therefore do not preclude a fast build-up process in the gas preceding streamer formation. Threshold measurements on both impulse and d.c. corona indicate that the steady glow type of corona has a different threshold than the streamer type. No formative lag data on the steady glow corona were obtained.

PA 57-5647

SM-6. Mickelsen, W. R. and H. R. Kaufman

N64-24030* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ELECTROSTATIC THRUSTORS FOR SPACE PROPULSION, PRESENT AND FUTURE

William R. Mickelsen and Harold R. Kaufman [1963] 71 p refs Presented at Brit. Interplanet. Soc. Symp. on Advanced Propulsion Systems, London, 9 Oct. 1963

(NASA-TMX-51764) OTS: $7.50 ph

Electrostatic thrustors are components of electric propulsion systems now being developed for space vehicles. The paper examines an existing experimental thrustor, states a number of deficiencies in it, gives reasons for these shortcomings in terms of the basic physical processes for each thrustor type, and summarizes research and development programs on these problems.

N64-24030, 16-27

SM-7. Mickelsen, W. R. and H. R. Kaufman

"Status of Electrostatic Thrustors for Space Propulsion," NASA Technical Note NASA TN D-2172, May 1964.

SM-8. Miller, C. G. and L. B. Loeb

5440. Negative coaxial cylindrical corona discharges in pure N_2, O_2, and mixtures thereof. C. G. MILLER AND L. B. LOEB. *J. Appl. Phys.*, 22, 614–21 (*May*, 1951).

Direct-current corona studies were made on coaxial cylinders with inner cylinder at negative potentials in pure N_2, pure O_2, and mixtures of 1% 10% O_2 in N_2, and on clean dry air from 27-mm to 760-mm pressure. Observations of current potential relations from field intensified ionization currents to as near breakdown as possible were made noting thresholds for current transitions, pulsed discharges and other oscillographic as well as visual appearances. Negative wire corona does not exist as such in truly pure N_2. Unless a high series resistance was in the line once the critical region of potential was reached, the gap broke down to an arc. With current-limiting resistor bombardment of the filament with positive ions from the low order pre-discharge released enough gaseous impurity so that after 6 min the resistor could be removed and the internal resistance of the negative ion space charge near the anode held the current at 2 000 μA. The behaviour indicated that breakdown was preceded by a low-current Townsend discharge that cleaned up or conditioned the filament. In all the negative-wire studies the onset thresholds vary with the past history of the wire, and the threshold potential at higher pressures overshoots the minimum operating potential of the discharge once it has set in. Studies with 1% O_2 indicate that the threshold discharge with clean gas is a continuous current with a diffuse glow which in time contracts to a cathode spot with Trichel pulses. Similar behaviour applies to air at lower pressure. There is evidence for a continuous heavy background of Townsend discharge along the whole wire until the visible spot and heavy pulsed discharge appears. Lower pressures in pure O_2 show many current transitions and transitions between discharge forms.

PA 54-5440

SM-9. Miller, C. G. and L. B. Loeb

4405. Positive coaxial cylindrical corona discharges in pure N_2, O_2, and mixtures thereof. C. G. MILLER AND L. B. LOEB. *J. Appl. Phys.*, 22, 494–503 (*April*, 1951).

D.C. corona studies were made from 27 mm to 760 mm pressure. Positive corona in pure N_2 does not exist as such. Pre-discharge Townsend currents by photon action on the cathode condition the outer Ni cathode until it spontaneously develops a glow discharge focusing in a spot on the anode wire. The discharge sets in at high potential and persists with lowering by hundreds of volts. Increase in current gives multiple spots and irregular current fluctuations. At lower pressure potential overshoot gradually disappears and the discharge begins as a regular glow discharge. Positive coronas with 1% O_2 show burst pulses at threshold, these being longer in duration (1 000 μsec) than in air because of spread down the wire. At lower pressure burst pulses lasted still longer. Breakdown streamers were observed at lower pressures where the applied potential was adequate. The Townsend equation for current in coaxial geometry applies above threshold both for N_2 and N_2 + 1% O_2. In air the positive corona sequence showing only burst pulses at threshold and breakdown streamers were observed. Burst pulses lasted 2 to 4 times those with 1 mm dia. point-to-plane corona in air owing to spread along the wire, which was less extensive than in 1% O_2. In pure O_2 the high absorption of photons ionizing the gas led to pre-onset streamers and no burst pulses at thresholds above 200 mm pressure. Below 200 mm streamer pulses and burst pulses, and below 50 mm only burst pulses, were observed. The streamers above 200 mm spread down the whole length of the tube by transparency of O_2 to photons liberating electrons from the Ni cathode cylinder.

PA 54-4405

SM-10. Molmud, P.

"Frictional Electricity in Missile Systems." ARS Journal 29, 73-4 (January 1959).

SM-11. Montgomery, D. J.

"Static Electrification of Solids." Solid State Phys. 9, 139-197 (1959). Academic Press, Inc., New York.

SN-1. Natanson, G. L.

"Diffusive Deposition of Aerosols on a Cylinder in a Flow in the Case of Small Capture Coefficients."
Doklady, Akad. Nauk 112, No. 1, 100-3 (1957).
Transl. available: Proc. Acad. Sci. USSR, Phys. Chem. Sect. 112, 21-5 (1957).

SN-2. Natanson, G. L.

"The Condensation of Aerosol Particles by Electrostatic Attraction on a Cylinder Around Which They are Streaming."
Dokl. Akad. Nauk, Phys. Chem. Section, 112, No. 1, 95-99 (1957).

SO-1. Oesterle, K. M.

OESTERLE 1957

Zum Einfluß des elektrostatischen Feldes auf Düsenaustrittgeschwindigkeit und Zerfall von Lackstrahlen (Influence of the electrostatic field on the nozzle outflow velocity and breakup of varnish jets). K. M. Oesterle. Schweiz. Arch. angew. Wissenschaft und Techn., Vol. 23, 1957, No. 12, pp. 404–413.

Study of physical and chemical factors on electrostatic atomization of paints, for obtaining an uniform coating.

de J II-299

SO-2. Oswald, W. J.

N64-22763* California U., Berkeley Space Sciences Lab.
DETECTION AND STUDY OF MICROORGANISMS IN THE UPPER ATMOSPHERE Progress Report

William J. Oswald et al. 3 Apr. 1963 25 p. refs *Its* Series 4; Issue 26
(Grant NsG-104-61)
(NASA-CR-50261) OTS: $2.60 ph

Research progress has been made in the following areas: (1) refinement and modification of electrostatic precipitator configuration; (2) generation of test aerosols; (3) study of electrical characteristics of the electrostatic precipitator under low air density conditions; (4) design of flight sampler; and (5) development of bacteriological techniques.

N64-22763, 16-15

SP-1. Papée, H. M., et al

25890 SOME POSSIBLE CHEMICAL CONTRIBUTIONS TOWARDS THE FORMATION OF THE ATMOSPHERIC ELECTRIC CHARGE.
H.M.Papée, T.W.Zawidzki, G.L.Petriconi and A.C.Montefinale.
Tellus (Sweden), Vol. 15, No. 2, 194-201 (May, 1963).

Laboratory experiments show that some solid particles which occur in the atmosphere can act as strong electron emitters when irradiated with visible light, while other substances, because of their chemical composition, can assume substantial negative electric charges. Implications resulting from these effects are discussed.

PA 66-25890

SP-2. Pauthenier, M.

"Lois de Charge des Particules Spheriques Conductrices dan un Champ Électrique Bi-Ionisé." Colloque International - La Physique des Forces Electrostatiques et Leurs Applications (Published by Centre National de la Recherche Scientifique, Paris, 1961).

On commence par rappeler les lois de charge, aujourd'hui classiques, des particules sphériques — conductrices ou diélectriques — dans le champ électrique mono-ionisé (exemple du champ cylindrique avec fil coronisant axial). Incidemment on rappelle qu'une première difficulté de la précipitation électrique peut résulter de *l'état de division* de la matière.

Une difficulté beaucoup plus grave se présente lorsque, dans certaines circonstances, l'électrode de dépôt émet des ions de signe contraire au fil coronisant (phénomène dit de *contre-émission* étudié dans la note n° 2. Le champ électrique est alors parcouru par un double flux d'ions des deux signes (champ bi-ionisé). Nous calculons ici *la nouvelle loi de charge des particules sphériques* dans le champ bi-ionisé. Dans le cas des sphérules *conductrices* qui fait l'objet précis de cette étude on trouve que la loi de charge est de forme exponentielle. *La charge limite* (ici statistique) peut être très faible; même si le champ électrique est peu changé par la c.e.m., la vitesse de précipitation se trouve réduite et l'efficacité de l'électrofiltre diminuée.

Si *dans la charge* les particules se comportent comme *isolantes*, M. REFFAY montrera que cette circonstance vient encore diminuer la charge limite et la vitesse de précipitation.

Author

SP-3. Pauthenier, M.

"Expériences de Poudrage Electrique des Végétaux." Colloq. Intern. Centre Natl. Rech. Sci. (Paris) No. 102, 275-78 (1961).

Dans la thérapeutique végétale, le champ électrique ionisé peut être un auxiliaire efficace : les fines particules utilisées sont chargées, puis précipitées par le champ électrique sur les plantes qui constituent l'électrode terre du montage. L'expansion spontanée du nuage électrisé permet la fixation des particules à l'intérieur même d'une masse de feuillages. La répartition de la poudre est excellente, et, par temps sec, son adhérence aux feuilles très énergique.

Author

SP-4. Pauthenier, M.

"Apparition de la Centre-Emission et des Champs Electriques Bi-Ionisés dans de Nombreaux cas de Dépoussiérage Edude Théorique Récente d'un Las Précis Conclusions." Colloq. Intern. Centre Natl. Rech. Sci. (Paris) No. 102, 263-73 (1961).

Depuis longtemps, de nombreux expérimentateurs ont signalé que si le dépôt de particules sur l'électrode de précipitation d'un électro-filtre a une résistivité suffisante, ce dépôt se perce d'une multitude de petits trous, origines d'aigrettes lumineuses de signe contraire au fil coronisant (phénomène de contre-émission). En même temps, le rendement de l'électrofiltre diminue.

Récemment un chercheur du Laboratoire a réalisé un cas de c.e.m. parfaitement uniforme en appliquant une toile de nylon à l'intérieur d'un cylindre de 30 cm de diamètre pourvu d'un fil coronisant axial, et il a fait une étude théorique de la question.

Une nouvelle équation de Poisson généralisée permet encore de résoudre le problème; moyennant quelques hypothèses simples contrôlées expérimentalement, on arrive à calculer, pour un courant total J correspondant à 1 cm de hauteur du cylindre, le champ bi-ionisé E, le courant excitateur J_1 (du fil coronisant) et le courant excité J_2 (courant de c.e.m.).

La détermination expérimentale de J_1 et J_2 se fait par exemple en mesurant au microelectromètre la charge limite d'une bille conductrice qui tombe dans le champ E.

Suivant l'importance de la c.e.m., et sans que le champ soit notablement modifié, le courant J peut être très supérieur au courant excitateur J_1 émis par le fil.

Par suite de l'abaissement de la charge limite des particules, l'efficacité de l'électrofiltre peut diminuer notablement (*cf.* Note 1). Des exemples numériques sont donnés.

Author

SP-5. Pauthenier, M. and R. Cochet

4457. Contribution to the study of losses in high-voltage d.c. lines through fog. M. PAUTHENIER AND R. COCHET. *J. Rech. Cent. Nat. Rech. Sci.*, 3 (*No.* 15) 337–42 (1951) *In French.*

See Abstr. 1286, 3671, 4137 (1951). Droplets of water form on the wires and, becoming pointed, emit ions resulting in power loss. Expressions are calculated for the movement of droplets in the neighbourhood of the wires and for the rate of capture of the droplets by the wire. In a particular case 10^{-2} g of water was collected per cm of conductor in 26 min, this being sufficient to cause emission of ions corresponding to a loss current of 30 μA/m.

EA 54-4457

SP-6. Pauthenier, M. and G. Duhaut

1600. A first contribution to the study of the electric losses in h.v. d.c. lines. Investigation of vibrating rain drops. PAUTHENIER, M. AND DUHAUT, G. *Rev. Gén. Elect.*, 58, 35-9 (*Jan.*, 1949) *In French.*—A test cylinder is described in which conductors suitable for d.c. transmission are examined and which permits visual observation in addition to measurements with the aid of a *c.r.o.* and a stroboscope. The mechanical movements and the currents emitted by water drops suspended from a test conductor are examined. Below the corona voltage of the conductor the water drops are found to oscillate and to give rise to a discontinuous current discharge. With increasing voltage the frequency of the oscillations decreases until the water drops act as fixed points and the current rises above 1 μA. An oscillographic record of the discharge current is given and the current bursts are correlated with the mechanical movements of the water drops.

EA 52-1600

SP-7. Pauthenier, M. G. Duhaut, and L. Demon

2452. Contribution to an investigation of the electric losses on h.v. d.c. lines. Particular study of water drops at fixed points. M. PAUTHENIER, G. DUHAUT AND L. DEMON. *Rev. Gén. Elect.*, 59, 133-6 (*March*, 1950) *In French.*

After earlier work [Abstr. 1600 (1949)] had shown the onset of mechanical vibrations and of electric losses from a stationary w drop at voltages below the normal breakdown strength of air, the change in the shape of a suspended water drop with increasing voltage is shown by a method of shadow photography and the discharge currents are plotted as a function of the gradient at the surfaces of conductors of varying diameters. From an estimate of the number of rain drops on a line conductor, the resulting electric losses are determined and the min. conductor diameter is derived which is required to avoid this type of loss for a range of surface gradients.

EA 53-2452

SP-8. Penney, G. W. and G. W. Hewitt

710. Electrically charged dust in rooms. G. W. PENNEY AND G. W. HEWITT. *Trans Amer. Inst. Elect. Engrs*, 68 (*Pt I*) 276-82 (1949).

Electrostatic precipitators operated at high cleaning efficiency have been very effective in keeping room walls and furnishings clean. At low cleaning efficiency serious trouble may arise because of escape of dust carrying electric charges of one sign into the rooms. The rate at which dust moves varies directly with the voltage gradient; and the rate of discoloration caused by space charge varies directly as the room size for geometrically similar rooms, as the second power of the dirt content of the air, and as the cube (approx.) of the precipitated inefficiency. Under particularly severe conditions a neutralizing scheme may be desirable, one being described.

EA 53-710

SP-9. Peskin, R. L. and R. J. Raco

1871. Peskin, R. L., and Raco, R. J., Drop size from a liquid jet in a longitudinal electric field, *AIAA J.* 2, 4, 781-782 (Tech. Notes and Comments), Apr. 1964.

A relationship between the drop sizes found by the breakage of an unstable liquid jet with and without the presence of a longitudinal electric field is developed. Experimental results are in satisfactory agreement with the relation derived.

AMR 18-1871

SP-10. Peskin, R. L. and R. J. Raco

"Some Results from the Study of Ultrasonic and Electrostatic Atomization." 1963 API Res. Conf. on Distillate Fuel Combustion, Paper CP 63-3.

SP-11. Petriconi, G. L., et al

13558 CHANGE OF SODIUM CHLORIDE SURFACES IN ELECTRIC DISCHARGES.
G.L.Petriconi, T.W.Zawidzki, A.C.Montefinale and H.M.Papée.
J. Phys. Chem. Solids (GB), Vol. 24, 573-7 (April, 1963).

A convenient and simple laboratory method for introducing surface defects into some powdered solids is described. The method is applied to monodisperse sodium chloride particles, and the extent of the chemical change associated with the defects is found to depend linearly on the specific surface of the halide.

PA 66-13558

SP-12. Pierce, C. M. (ed.)

N64-20531 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DETECTION TECHNIQUES AND ATMOSPHERIC DISPERSAL OF TOXIC GASES AND AEROSOLS: AN ANNOTATED BIBLIOGRAPHY
Charlie M. Pierce, comp. Apr. 1963 65 p refs
(SB-63-39; Rept.-3-32-63-1)

Potential and actual environmental hazards from diffusible toxic agents and the use of meteorology to help evaluate, understand, and minimize these hazards have become increasingly significant. The scope of this bibliography includes such areas as detection techniques and instrumentation, dispersion by winds, and the physiological effects of atmospheric contaminants. The references are arranged according to the first author, wherever possible. Indexes for corporate author, personal author, and subject are included.

N64-20531, 13-21

SP-13. Plumlee, H. R.

N65-18143# Illinois U., Urbana. Charged Particle Research Lab.
EFFECTS OF ELECTROSTATIC FORCES ON DROP COLLISION AND COALESCENCE IN AIR
Hubert Russel Plumlee (M.S. Thesis) 25 Sep. 1964 115 p refs
(Grants AMC-63-G2; NSF GP-2528)
(CPRL-8-64; AD-608382) OTS: $4.00

The coalescence of a pair of drops 2 millimeters in radius, immersed in air, is investigated by first considering a mathematical model which includes the hydrodynamic flow of the air from between the two approaching surfaces, the effect of the flattening of the adjacent surfaces, and the effect of an electric potential between the drops. With this model, the time required for the surfaces to move a given distance is determined

as a function of the viscosity of the air and the potential difference. High-speed photographs of the profile view of two colliding drops are used in support of this model. The time interval between the initial deformation of the approaching drops and their coalescence, the rate of growth of the flatten deformation of the adjacent surfaces, and the collision velocity of the drops are measured. It was found that the time for coalescence is independent of moderate charges in the air pressure, varies inversely with the potential difference, and decreases for an increase in the collision velocity. Also, the time interval during which charge flows between the drops before they actually coalesce is investigated

N65-16143, 06-12

SP-14. Pohl, H. A.

16240 FORMATION OF LIQUID JETS IN NONUNIFORM ELECTRIC FIELDS. H.A.Pohl.
J. appl. Phys. (USA), Vol. 32, No. 9, 1784-5 (Sept., 1961).

A note on the paper by Morgan and Edwards (preceding abstract) suggesting that the fountain effect is a combination of dielectrophoresis and electrophoresis.

PA 64-16240

SP-15. Pohl, H. A.

282. SOME EFFECTS OF NONUNIFORM [ELECTRIC] FIELDS ON DIELECTRICS. H.A.Pohl.
J. appl. Phys., Vol. 29, No. 8, 1182-8 (Aug., 1958).

Experimental and theoretical studies show the effects to be rather striking for particles larger than molecular size. The results show that the effect can be used to produce a fairly efficient pumping action of non-conducting liquids, to cause continuous and easily measurable separations in coarse suspensions, to cause selective precipitation, and to produce mixing. By this means, liquids may be thrown several feet into the air with an electromechanical efficiency of about 25%. A separation factor of at least 2.5 in continuous separation operation may be produced in a suspension of polyvinyl chloride in carbon tetrachloride—benzene mixture. Suspensions of polar materials in less polar liquids may be either dispersed or precipitated. In one "demonstration" type of experiment, drops were "hung" in mid air.

PA 62-282

SP-16. Potekhina, N. D.

26023 THEORY OF SURFACE IONIZATION.
N. D. Potekhina.
Zh. Tekh. Fiz. (USSR), Vol. 34, No. 6, 1066-91 (June 1964). In Russian. English translation in: Soviet Phys. Tech. Phys. (USA), Vol. 9, No. 6 (Dec. 1964).

The temperature dependence of the flux of ions and atoms with surface ionization is examined for two cases of adsorption. In the first case, the level of adsorbed atoms entering the forbidden band (semiconductors) is considered; in the second case, the conduction band is involved. It is assumed that the degree of filling is small enough for interactions between the adsorbed atoms to be neglected. The condition for which the heat of evaporation of ions can be determined from the $J_+(T)$ dependence is shown (J_+ is the flux of ions at the surface). The application of the Sax–Langmuir formula for surface ionization on semiconductors is demonstrated. This is a contradiction of the work of Avak'yants (1953-54).

PA 67-26023

SP-17. Pruppacher, H. R.

10720 THE EFFECTS OF ELECTRIC FIELDS ON CLOUD PHYSICAL PROCESSES. H. R. Pruppacher.
Z. Angew. Math. Phys. (Switzerland), Vol. 14, No. 5, 590-9 (25 Sept. 1963).

A review of literature on the effects of electric fields on drop collision and coalescence, on the growth of ice particles, and on ice nucleation in supercooled water.

PA 67-10720

SP-18. Pruppacher, H. R.

368 THE EFFECT OF AN EXTERNAL ELECTRIC FIELD ON THE SUPERCOOLING OF WATER DROPS.
H. R. Pruppacher.
J. Geophys. Res. (USA), Vol. 68, No. 15, 4463-74 (1 Aug. 1963).

The effect of electric fields on the supercooling of water drops was studied by a special experimental technique which permitted the observation of the action on water drops of a d. c. electric field of 1 to 30 kV/cm. These experiments, documented by a motion picture film, showed that freezing could be initiated in the water drops at a temperature which was only a few degrees below 0°C by applying external electric fields which had field strengths of several kilovolts per centimetre. It was found that the electrofreezing effect was not due to an orientation of water molecules in the water sample, nor was it due to particulate matter produced by sparks or corona discharges since no such discharges took place during the experiments. It was found that the effect was a consequence of the movement of the drop in the electric field along a solid surface. It was concluded from the experiments (1) that an external electric field is able to activate the ice-nucleability of a solid surface and (2) that the characteristics of the effect make it very unlikely that freezing can be initiated by electric fields in atmospheric clouds since the solid surfaces with which the drops have to be in contact during their deformation are not present in mature thunderstorm clouds.

PA 67-368

SP-19. Pudovkina, I. B. and Yu. S. Sedunov

7846 PRIMARY MECHANISM FOR CHARGING AN AEROSOL LAYER AND SUBINVERSION STRATOCUMULUS CLOUDS.
I. B. Pudovkina and Yu. S. Sedunov.
Izv. Akad. Nauk SSSR, Ser. Geofiz., 1963, No. 6, 966-77. In Russian. English translation in: Bull. Acad. Sci. USSR, Geophys. Ser. (USA), No. 6, 592-7 (June 1963; publ. Oct. 1963).

Results of measurements of the atmospheric electric field over a net of high mountain stations during the formation and development of valley clouds are given. A model for charging an aerosol layer when the vertical stream of ions through the atmospheric electric field is disturbed is considered. A qualitative comparison is made between variations in electrical characteristics obtained from model calculations and experiment.

PA 67-7846

SR-1. Rayleigh, (Lord)

"On the Equilibrium of Liquid Conducting Masses Charged with Electricity."
Phil. Mag. 14, 184-186 (1882)

SR-2. Reffay, R.

"Lois de Charge des Particules Spheriques Isolantes en Champ Electrique Mono-Ionisé et Bi-Ionisé."
Colloq. Intern. Centre Natl. Rech. Sci. (Paris) No. 102, 255-62 (1961)

On se propose d'expliquer le mécanisme de la charge des particules diélectriques sphériques (qui constituent la quasi totalité des poussières provenant des centrales thermiques), dans un champ électrique ionisé, analogue à celui des filtres de dépoussiérage.

La poussière qui capte des ions est soumise à un couple électrique ayant tendance à la faire basculer. Ce couple subsiste tant que la densité superficielle de charge n'est pas uniforme. Les poussières de quelques microns de diamètre ont un moment d'inertie extrêmement petit; elles peuvent pivoter très rapidement et la densité superficielle est pratiquement uniforme à chaque instant.

Dans ces conditions, l'équation des lignes de force, au voisinage d'une sphère diélectrique, est analogue à celle correspondant aux sphères conductrices. On obtient pour expression de la charge limite prise par une sphère :

$$Q_l = \frac{3\varepsilon}{\varepsilon + 2\varepsilon_0} \varepsilon_0 E a^2 \frac{\gamma - 1}{\gamma + 1} \qquad \text{avec} \qquad \gamma = \sqrt{\frac{k_+ \rho_+}{k_- \rho_-}}$$

Cette expression est valable pour les diélectriques en champ bi-ionisé, ainsi que pour les conducteurs en champ bi-ionisé ($\varepsilon \to \infty$). On peut aussi l'appliquer en champ mono-ionisé, en écrivant que $\gamma = 0$ ou que $\gamma = \infty$, suivant le signe des ions émis par le fil coronisant.

La charge prise par une poussière diélectrique, dans un filtre de dépoussiérage, a même signe que les ions émis par le fil. Elle est inférieure à celle prise par une poussière conductrice. La précipitation sera défectueuse pour trois raisons :

1) Influence de la permittivité du diélectrique;

2) Mauvaise neutralisation des particules sur la paroi, entassement du dépôt et contre-émission;

3) Si leur diamètre est trop grand, la rotation des poussières sur elles-mêmes n'est pas assez rapide pour que la densité de charge soit uniforme; la charge limite diminue. Elle serait nulle si la rotation cessait.

Author

SR-3. Reynolds, J. M.

7924 STABILITY OF AN ELECTROSTATICALLY SUPPORTED FLUID COLUMN. J. M. Reynolds.
Phys. of Fluids (USA), Vol. 8, No. 1, 161-70 (Jan. 1965).

An analytical and experimental study has been made of the cylindrical interface between two dielectric liquids under the influence of electrostrictive forces and surface tension. The analysis indicates that, for "high"-frequency applied fields such an interface can be stable. For stability, the applied voltage must be great enough to suppress tension effects and lower than some analytically determined critical value. For voltage greater than this critical value, experiments indicate that the interface is deformed in an unusual manner.

PA 68-7924

SR-4. Richards, H. F.

"The Contact Electricity of Solid Dielectrics."
Phys. Rev. 22, 122-33 (1923)

The electric charges produced by wringing optically flat surfaces together were measured in order to determine whether or not there is a possibility of formulating a single contact theory which will include both the metals and the dielectrics. Experiments with flint glass and steel proved that the frictional charge is independent of the amount of friction, provided only that intimate contact be established, and is proportional to the area of contact. *The voltaic nature of the frictional charge.* The charge was in no wise affected by the ionization of the residual air molecules between the surfaces by means of an intense beam of x-rays, and was also found to be independent of the duration of contact for periods varying up to 17 hours. The failure of the double-layer to recombine under these conditions proves that it was sustained by a voltaic field. *The dependence of the effect on the dielectric constant.* The charge per cm² Q_{12} of material 1 in contact with material 2, was found for 8 different pairs of the materials, *quartz, fluorite, crown glass, flint glass and steel*, to satisfy, within 14 per cent, the equation $Q_{12} = C(K_1 - K_2)$, where K_1 and K_2 are the dielectric constants and C is a positive constant, whose mean value is 4.43 e.s.u., provided the value $K = 3.1$ be assigned to steel. This equation is consistent with the results of Coehn's measurements of electric osmosis.

The electric effect of compressing amorphous dielectrics was determined by pressing two kinds of sheet rubber, of dielectric constants 2.94 and 3.96, against seven hard materials, whose dielectric constants ranged from 2.8 to 7.8. The charge on the compressible dielectric was found to be independent of the nature of the material against which it was pressed, proving that this is not a voltaic effect and that amorphous as well as crystalline substances can be electrified by pressure.

The electric effect of collision of a solid insulator and a metal was found, with four pairs of materials, to be consistently opposite in sign to the frictional effect. This result shows that collision must be considered to produce two different effects, one of which is the voltaic charge, while the other is a transfer of electrons from the metal to the dielectric, due in all probability to the inertia of the mobile electrons.

Dielectric constant of steel, as suggested by these results, is not infinity but 3.1.

Author

SR-5. Richards, H. F.

"Electrification by Impact."
Phys. Rev. 16, 290-304 (1920).

Electrification by Impact; Measurement of the Charge Produced by Collision between a Metal and a Dielectric.—After briefly discussing the unsuccessful attempts which have been made to formulate a satisfactory theory to explain electrification by friction, the author suggests that impact of dielectric upon metal, without sliding friction, may cause an electrical effect whose laws will shed light upon the frictional phenomenon. An apparatus is described for measuring the electric charge produced when a disc or sphere of dielectric material collides with a metal disc. The charges obtained in this manner ranged from 0.16 to 9.83 e.s.u., and produced potentials of 2.41 to 183.8 volts upon the metallic systems employed. These charges are of the same order of magnitude as those obtained by friction. The experiment was performed with *various metals and dielectrics*, and in every instance the metal received a positive charge. In no case was there any evidence of the erratic variation which others have found to be characteristic of electrification by friction. Curves are given which show the *variation of charge with velocity of impact* and with the *mass of the impinging system*. The charge produced by a single collision increases with each of these factors but the velocity of impact was found to exert a greater influence than the mass of the moving body in determining the amount of the charge. In certain cases velocities were attained at which the electrification due to a single impact reached a maximum value.

Relation of Charge to Capacity.—The quantity of charge produced by a given collision was shown to be independent of the capacity of the metallic system.

Effect of Repeated Impacts.—When many impacts were performed in rapid succession, the amount of charge increased to a maximum. This maximum was shown to be conditioned rather by the quantity of charge present upon the dielectric than by the potential of the metal anvil.

Discussion of Results.—The author concludes that there is no direct dependence of the electrical energy upon the mechanical energy lost in impact, and that electrification by impact is similar in nature to the contact effect between metals. The results are considered to support Helmholtz's theory regarding the nature of electrification by friction.

Author

SR-6. Robertson, A. J. B., B. W. Viney and M. Warrington

12687 THE PRODUCTION OF POSITIVE IONS BY FIELD IONIZATION AT THE SURFACE OF A THIN WIRE.
A.J.B.Robertson, B.W.Viney and M.Warrington.
Brit. J. appl. Phys., Vol. 14, No. 5, 278-83 (May. 1963).

Wires of platinum and tungsten 4-10 μ in diameter were used. They were placed along the axis of a coaxial cylinder. When the wire was charged positively with respect to the cylinder and any of the gases ethylene, water, oxygen, nitrogen, nitrous oxide, ammonia, carbon monoxide and hydrogen was present, a current was observed, with a voltage between wire and cylinder less than 20 kV. The current was directly proportional to gas pressure except with water and ammonia. It appeared to be due to field ionization at the surface of the wire. Currents exceeding 10^{-7} A were obtained with wires 2 cm long. Field ionization was also brought about with a thin wire between parallel plates. With the plates apparatus and with the cylinder apparatus, a fraction of the ions produced could be extracted through a slit cut in one plate, or in the cylinder. The electric field at the wire surface was not great enough, for a smooth surface, to produce field ionization. It is proposed that a considerable local intensification of field occurs because of surface roughness. The field intensification factor for a 10 μ diameter platinum wire was investigated by measuring the field emission of electrons from the wire, first as a function of field at constant temperature and secondly as a function of temperature at constant field. The temperature variation of field emission from 650-1375°K agreed very well with the theory given by Good and Müller (1956). Corrections for thermionic emission at the higher temperatures from the flat parts of the surface were made with a method which used the Schottky equation. The field intensification factor found in this way was 70. Such a value explains the occurrence of field ionization.

PA 66-12067

SR-7. Rohmann, H.

"Messung der Grösse von Schwebeteilchen."
Z. Phys. 17, 253 (1923).

SR-8. Rose, G. S. and S. G. Ward

"Contact Electrification across Metal-Dielectric and Dielectric-Dielectric Interfaces." Brit. J App. Phys. 8, 121-6 (March 1957).

An apparatus is described by means of which a spherical dielectric surface can be compresse under various loads against either a plane metal disk or a plane dielectric disk. A transfer c electric charge across the interface is recorded when the surfaces are separated. The polarit of charging between any two materials depends upon the relative positions of those material in an electrostatic series; a metal surface does not always assume a positive charge as found fo impact electrification. For two given materials the amount of charge is proportional to th contact area between the surfaces and provided that one of the surfaces has a resistivity abov a critical value (5×10^{11} Ω cm) then the charge density for various combinations of material is approximately proportional to the lower dielectric constant in each combination. This resul suggests that the charging may be limited by electrical back-discharge between the separatin surfaces. It is considered to be unlikely that the electrification originates from a difference i the contact potentials of the two surfaces involved.

Author

SR-9. Rossano, A. T. and L. Silverman

"Electrostatic Effects in Fiber Filters for Aerosols."
Heating and Ventilating 51, 102-8 (May 1954).

SR-10. Russell, A.

"The Problem of Two Electrified Spheres."
Proc. Phys. Soc. 35, 10-29 (1922).

SR-11. Russell, A.

"A Treatise on the Theory of Alternating Currents."
Vol. I, Second Edition.
Cambridge University Press, London, 1914.

SR-12. Russell, A.

"The Coefficients of Capacity and the Mutual Attractions or Repulsions of Two Electrified Spherical Conductors when Close Together."
Proc. Roy. Soc. A 82, 524-31 (1909).

SR-13. Ryce, S. A.

"An Equilibrium Value for the Charge-to-Mass Ratio of Droplets Produced by Electrostatic Dispersion."
J. Colloid Sci. 19, No. 5, 490-2 (1964).

CA 61-10080f

SS-1. Salt, R. W.

"Effect of Electrostatic Field on Freezing of Supercooled Water and Insects."
Science 133, 458-9 (Feb. 17, 1961).

Abstract. Supercooled water and two species of insects froze at higher temperatures than normally when placed in an electrostatic field. The effect became more certain and occurred earlier as the amount of supercooling was increased. The amount of supercooling in the presence of the electrostatic field was not related to the amount in its absence.

Author

SS-2. Sayasov, Yu. S.

12405. ON EQUILIBRIUM IONIZATION PRODUCED BY DUST PARTICLES. Yu.S.Sayasov.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 5, 848-51 (1958). In Russian.
Gives a full theoretical analysis of the equilibrium ionization produced by spherical microscopic particles. The general equation obtained, can be used with the help of elliptical θ-functions, for the calculation of the concentration of electrons. Shows how the equation is reduced in limiting cases to: (a) Saha's equation at sufficiently low temperatures; (b) Einbinder's equation (see Abstr. 5436 of 1957; and 4084 of 1958) at sufficiently high temperatures.

PA 62-12405

SS-3. Schneider, J. M. and C. D. Hendricks

"Source of Uniform-Sized Liquid Droplets."
Rev. Sci. Inst. 35, No. 10, 1349-50 (Oct. 1964).

SS-4. Schnitzler, H.

"The Rate of Charging of Dust in a Corona Field."
Schriftenreihe Staub Heft 40, 221-36 (1955).

SS-5. Schulman, J. H. and H. C. Parreira

N64-25778 Columbia U., New York, N.Y. Stanley-Thompson Lab.
ELECTRICAL PHENOMENA AT THE ICE/WATER INTERFACE
Jack H. Schulman and H. C. Parreira Jun. 1964 25 p refs
(Contract Nonr-266(64))
(TR-1)

The experimental equipment designed for investigating electric phenomena that occur at the ice-water interphase is described. This equipment consists of an automatic apparatus for recording streaming potentials on ice-water systems, the main components of which are the streaming potential cell, the solution reservoirs and pressure ballast, the pressure gage, pressure transducer, and the electronic circuit, and an apparatus for producing and measuring electric potentials at the ice-water interphase during freezing. The main components of the latter are the freezing potential cell, the freezing well, and the measuring and recording devices. This equipment will be used to study the electric potentials generated whenever liquid water is forced through ice capillaries under pressure gradients (streaming potentials), and the electric potentials that appear during the freezing of water of dilute aqueous solutions (freezing potentials). N64-25778, 17-09

SS-6. Schultz, R. and L. Branson

"The Colloid Rocket: Progress toward a Charged-Liquid-Colloid Propulsion System." 2nd Symp. on Advanced Propulsion Concepts, Boston, Oct. 7-8, 1959.

SS-7. Schultz, R. D. and R. E. Wiech

"Electrical Propulsion with Colloidal Materials." AGARD Combustion and Propulsion Panel Tech. Meeting on "Advanced Propulsion Concepts." Pasadena, California, August 24-26, 1960.

SS-8. Schütz, A.

"Investigations of the Unipolar Type Charges of Highly Dispersed Aerosols." Thesis, Physikalisches Institut der Universität Mainz, 1956.

SS-9. Schütz, A.

8671. An Arrangement for Recording Contact-Electrical Measurement of Dust.—A new arrangement for recording dust measurement is reported in which concentrations of 0.1 mg/m³ >5 μm can be clearly indicated. The apparatus continuously measures the charge formed on a metal probe by contact-electrical processes upon the impact of solid suspended particles with the probe. (*In German.*) Eine Anordnung zur registrierenden kontaktelektrischen Staubmessung. — Alfred Schütz. *Staub*, v. 24, Sept. 1964, p. 359-363.

BMI 13-8674

SS-10. Shashoua, V. E.

"Static Electricity in Polymers II. Chemical Structure and Antistatic Behavior."
J. Polymer Sci. A. 1, 169-187 (1963).

SS-11. Shashoua, V. E.

"Static Electricity in Polymers I. Theory and Measurement."
J. Polymer Sci. 33, 65-85 (1958).

SS-12. Sher, L. D. and H. P. Schwan

"Microelectrophorisis with Alternating Electric Fields."
Science 148, 229-31 (April 9, 1965).

SS-13. Silverman, L.; E. V. Connors, and D. M. Anderson

"Mechanical Electrostatic Charging of Fabrics for Air Filters."
Ing. Eng. Chem. 47, 952-60 (1955).

Test results are presented in which a mechanically induced electrostatic charge on certain fabrics is employed as an aid in the removal of particulate matter (atmospheric dust) from air at room temperature. The theory of mechanically induced static charges and some experimental data are presented. A so-called tribo-electric series of common fibers is developed. The electrostatic mechanism of aerosol filtration for the three most important precipitating forces is described. Tests were made on a two-stage fabric filter unit using a fixed fabric A, charged to one sign by contact with a moving fabric surface B, as an aerosol conditioning (charging) stage. This was followed by a moving belt of fabric B acting as the collecting stage which was charged by a moving fabric surface A. Test results show that the basic uncharged collection efficiency of the unit on atmospheric dust can be doubled due to the mechanically induced charge at no increase in resistance to air flow. Other results show the effects of particle conditioning, filtering velocity, fabric charge, type of fiber, and humidity on efficiency.

Author

SS-14. Smith, F. T.

6006. ON THE IONIZATION OF SOLID PARTICLES. F.T.Smith. J. chem. Phys., Vol. 28, No. 4, 746-7 (April, 1958).

An extension of the work of Einbinder (Abstr. 5436/1957) to negatively charged particles. The results are presented as a graph of the ratio of true electron density to saturation density (always less than unity) versus inverse temperature.

PA 61-6006

SS-15. Smith, P. L. and G. W. Penney

"The Charging of Non-spherical Particles in a Corona Discharge."
AIEE Conference Paper presented at the Winter General Meeting, New York, Feb. 1961.

SS-16. Sodha, M. S.

9731 THERMAL AND PHOTOELECTRIC IONIZATION OF SOLID PARTICLES. M.S.Sodha.
Brit. J. appl. Phys., Vol. 14, No. 4, 172-6 (April, 1963).

A discussion of the various physical processes relevant to the ionization of solid particles is given. Detailed considerations of the rates of thermionic and photoelectric emission from charged particles, electron attachment and recombination with charged particles and energy exchange in these processes are presented. From these considerations an expression for the equilibrium constant of the ionization reaction of solid particles was derived. This expression has been used by earlier workers based on intuitive considerations in their investigation of the charge distribution of particles in thermal equilibrium. The steady state and transient charge distribution and energy exchange under non-equilibrium conditions were also investigated. Expressions for refractive index and absorption coefficient of the medium for electromagnetic waves were derived.

PA 66-9731

SS-17. Sodha, M. S.

3066 THERMIONIC EMISSION FROM SPHERICAL METALLIC PARTICLES. M.S.Sodha.
J. appl. Phys. (USA), Vol. 32, No. 10, 2050-60 (Oct., 1961).

An expression for the rate of thermionic emission from a charged spherical metallic particle, where the free electron theory is applicable, was derived. This expression was used to investigate the charging of particles owing to thermionic emission in the absence of surrounding space charge. PA 65-3066

SS-18. Soo, S. L., J. A. Hultberg, G. J. Trezek and R. C. Dimick

N64-18857 Illinois U., Chicago
PROPERTIES OF TWO-PHASE FLOW -- ELECTRIC PHENOMENA
S. L. Soo, J. A. Hultberg, G. J. Trezek, and R. C. Dimick. *In* Va. U. Project Squid 1 Apr. 1964 p 25-29 refs (See N64-18851 11-24)

The interaction of solid particles with an ionized gas, their electrification by thermal and surface interaction, and the dynamics of a two-phase flow including charged solid particles were investigated. Measurements of oxides and metals in an arc-heated jet of argon show that, in the interaction of an ionized gas and solid particles, the solid particles may collect electrons by their capacitance, a process that is in competition with thermionic emission from the solid particles. The combination of low thermionic potential and high ionization potential tends to leave the particles negatively charged. The delaying nature of oxides on recombination processes explains the significance of an oxide in a rocket jet on its electron concentration. In the case of alumina, the effect of thermal electrification plays a significant part in slowing the recombination process. The radio-wave attenuation by a rocket jet, due to free electrons in the gaseous phase, is influenced by the material of the solid particles in the jet. It is indicated that the electric charge effect far overshadows the two-dimensional effect in a nozzle flow (two-phase flow).

N64-18857, 11-24

SS-19. Soo, S. L., G. J. Trezek, R. C. Dimick, and G. F. Hohnstreiter

"Concentration and Mass Flow Distributions in a Gas-Solid Suspension." Ind. and Eng. Chem. Fund. 3, No. 2, 98-106 (May 1964).

Distributions of concentration, mass flow, and velocity of solid particles were studied with a fiber-optic probe and an electrostatic probe. Concepts concerning these distributions and electrostatic charges on solid particles were furthered and substantiated. The relation between electrostatic charge on solid particles and diffusivity of solid particles, and the difference between static loading and mass flow ratio of phases were proved.

Author

SS-20. Stern, S. C., D. R. Steele, and O. E. A. Boldaun

"A Large-Volume Electrostatic Air Sampler." AMA Arch. Ind. Health 18, 30-33 (1958).

SS-21. Straubel, H.

"Motion of an Electrically Charged Particle and its Observation." Z. Aerosol Forsch. u Therap. 4, 385-91 (1955).

SS-22. Sweet, R. G.

7915 HIGH FREQUENCY RECORDING WITH ELECTROSTATICALLY DEFLECTED INK JETS. R. G. Sweet.
Rev. Sci. Instrum. (USA), Vol. 36, No. 2, 131-6 (Feb. 1965).

A high speed oscillograph, using ordinary ink and paper, has been developed that provides a new approach to the old problem of producing instantly visible, high frequency records with inexpensive writing materials. A high speed jet of ordinary fountain-pen ink is divided into a uniform procession of drops, each of which is independently charged in proportion to an input-signal voltage. After projection through a constant transverse-deflecting field, the charged drops are collected on a moving chart to form an instantly visible, permanent record of the input signal. Drops are typically formed at a rate of 100 000 sec^{-1}; each has an independent trajectory and makes an individual mark representing an independent sample of the input waveform. The ink stream may be switched on or off at high speed by providing, between the drop-launching point and the record surface, a collector that intercepts drops having a specific trajectory. Besides oscillography, which is discussed in detail, the technique has applications in other fields requiring marking at high speed or marking without pressure or physical contact.

PA 68-7915

ST-1. Tamura, T.

"Ionizing Radiations Excited in a Positive Burst Pulse Corona in H_2."
Japan. J. App. Phys. 2, No. 8, 492-99 (Aug. 1963).

The onset of a positive burst pulse corona was measured at different pressures in hydrogen. From the extrapolated value of reduced field streng h to indefinitely high pressure the effective absorption coefficient of the radiation active in the formation of a positive burst pulse corona was deduced. The estimated values differ for different values of the field strength at the tip of the positive electrode. It seems that there are at least three components of radiation with values of absorption coefficient p_{760} 0.095, 215 and 1500 cm^{-1} active at values of E/p_0 around 23~31, 110~660 and 1000~9600 volt $cm^{-1}Torr^{-1}$ respectively.

Ratio f of numbers of ionizing photons to ions and excitation coefficient were calculated for these components. A possible explanation for the excitation of the most penetrative component is also presented.

Author

ST-2. Tamura, T.

"Formation of a Positive Burst Pulse Corona in Air, N_2, and O_2."
J. Phys. Soc. Japan 17, No. 9, 1434-39 (Sept. 1962).

Loeb's condition for the onset of a positive burst pulse corona was applied to the case of point-to-point electrodes arrangement and a formula, which gives relations between the field strength to pressure ratio, ratio of ionizing photons to electrons in an avalanche and the effecti:e absorption coefficient for this ionizing radiation, was obtained.

From the measured starting potential *versus* pressure curve the limitting value of the field strength to pressure ratio for the case of indefinitely high pressure was obtained by extrapolation, and from this value the effective absorption coefficient μ for the burst pulse forming radiation was estimated.

The estimated values for the effective absorption coefficients at 760 Torr are 3700 cm^{-1} for air, 2375 cm^{-1} for nitrogen and 2200 cm^{-1} for oxygen. As these values are of the same order of magnitude as for the radiations in the range of the resonance bands in the ionization continua, the wavelength of the ionizing radiations effective in the positive burst pulse corona formation might be assumed to be in the range of the ionization continua. Moreover the ratios of the numbers of ionizing photons to those of electrons in a burst forming avalanche were deduced. They are approximately 1.6~1.8 for air, 1.4~1.5 for nitrogen and 1.8 ~1.9 for oxygen.

Author

SU-1. Uberoi, M. S. and C-Y. Chow

21950 INSTABILITY OF A CURRENT-CARRYING FLUID JET ISSUING FROM A NOZZLE.

M.S.Uberoi and Chuan-Yen Chow.
Phys. of Fluids (USA), Vol. 6, No. 9, 1237-41 (Sept., 1963).

The velocity across a jet becomes nonuniform due to contraction or expansion of fluid in the presence of electric current within the nozzle from which it issues. The results obtained elsewhere on the instability of a jet of uniform velocity due to electric current and surface tension are corrected. It is further shown that velocity nonuniformity reduces this instability. The available data on the instability of a mercury jet issuing from a contraction are for small current density and, hence, low velocity nonuniformity. However, for reasons yet unknown, the data do not agree with the (corrected) theory for the case of uniform velocity.

PA 66-21950

SV-1. Velkoff, H. R. and J. H. Miller

A65-10873 *
CONDENSATION OF VAPOR ON A VERTICAL PLATE WITH A TRANSVERSE ELECTROSTATIC FIELD.
H. R. Velkoff and J. H. Miller (USAF, Systems Command, Research and Technology Div., Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio).
American Institute of Chemical Engineers and American Society of Mechanical Engineers, Heat Transfer Conference and Products Show, Cleveland, Ohio, Aug. 9-12, 1964, Paper 64 - HT-13. 5 p. 14 refs.
Members, $0.50; nonmembers, $1.00.

Description of an exploratory experimental program to determine the improvements in heat transfer which could be achieved in the condensation of vapor by the application of electrostatic fields. Freon-113 was utilized as the working fluid in the tests, and condensation of the Freon vapor was produced on a cooled vertical copper plate. A series of electrodes was utilized to vary field strength and geometric configuration of the field, and the particular electrostatic action being studied. Results of the tests indicated that very large increases in heat transfer can be obtained with the use of screen electrodes placed parallel to the cooled copper plate. Increases of 150% were achieved which were controllable and readily reproducible.

A65-10873, 02-33

SV-2. Velkoff, H. R. and J. H. Miller

N64-21178 Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
THE EFFECT OF AN ELECTROSTATIC FIELD ON THE CONDENSATION OF VAPOR Technical Documentary Report, Sep. 1962-Aug. 1963
Henry R. Velkoff and John H. Miller Feb. 1964 54 p refs (RTD-TDR-63-4008; AD-433238)

This experimental program was conducted to determine whether electrostatic fields could be applied effectively to increase the heat-transfer coefficient in the condensation of vapor. A series of tests using several types of electrodes and various field strengths was conducted to study the effects of various electrostatic actions on the condensation process. In these tests, Freon-113 was vaporized in a tank and condensed on a cooled copper plate. Results of these tests indicate that large increases in heat-transfer coefficient can be realized by applying an electrostatic field with a screen electrode placed parallel to a cooled copper plate. The increases were controllable and readily reproduced.

N64-21178, 14-13

SW-1. Wagner, P. E.

1247. ELECTROSTATIC CHARGE SEPARATION AT METAL–INSULATOR CONTACTS. P.E.Wagner.
J. appl. Phys., Vol. 27, No. 11, 1300-10 (Nov., 1956).

An investigation has been made of the electrostatic charge produced in vacuum on several inorganic insulators when they are put into rolling contact with nickel, platinum and copper surfaces. The primary role of relative motion is to increase the area on the insulator that ultimately undergoes contact, thereby increasing the total charge separated. With quartz, all evidence favours electron transfer which occurs because the nonconductor has a higher effective work function than the metal. Field emission-induced back leakage of electrons during separation of the charged surfaces is considered to reduce the charge originally separated to that actually measured. Little difference is seen between the charging properties of quartz cleaned chemically in room air and quartz subsequently outgassed at 700°C in vacuq better than 10^{-6} mm Hg. No difference in electron affinity is found between fused and monocrystalline quartz. No evidence directly supporting electron transfer is found for the other insulators tested, synthetic single crystals of Al_2O_3, MgO, NaCl, KCl, KBr and KI; and the possibility of ion transfer is considered. All charge against nickel much less vigorously and less reproducibly than does quartz. The alkali halides and MgO which contains excess Mg or O as a bulk impurity charge positively, while stoichiometric MgO charges negatively. With Al_2O_3, there is a strong dependence of charge density on crystallographic orientation. Alteration of charging properties by surface and/or bulk conduction is found to be negligible for all insulators tested, within the reproducibility of the charging measurements.

PA 60-1247

SW-2. Ward, A. L.

"Ionization, Diffusion, and Drift Velocities in a Pulsed Townsend Discharge."
J. Appl. Phys. 36, No. 4, 1291-4 (April 1965).

Introduction.—It is one of the familiar properties of ultramicroscopic particles that some portion of any given type are electrically charged. Moreover, it is now accepted that the charges carried by any such particles are always multiples of the elementary unit, the electron. When the particles are not ionized by some powerful agent, the charged particles form but a fraction of the whole number and most of the charged particles possess but a single electron. Compared with the number carrying one electron, in statistical work the number doubly charged is negligible. The observed motion of the particles in a given electrostatic field is thus a measure of their size.

SW-3. Wasser, E.

377. Measurements of the Charge on Selenium Particles at High Gas Pressures. E. Wasser. *Zeits. f. Physik*, 78. 7–8. *pp.* 492–509, *Oct.* 12, 1932.—Measurements with selenium particles dispersed in an inert gas at pressures up to 30 atmospheres, at which the mean free path is very small, show that the charges on all the particles approximate to that of the electron, and provide no evidence in support of the view that smaller charges exist; many of the particles, however, exhibit deviations from the normal structure and density of the material in bulk, and previous reports regarding the existence of smaller charges than that of the electron are attributed to such deviations.

PA 36-377

SW-4. Watson, P. K. and A. H. Sharbaugh

29845 CHARGE-STORING TECHNIQUE FOR MEASURING SMALL CONDUCTION CURRENTS UNDER MICROSECOND PULSE CONDITIONS. P.K.Watson and A.H.Sharbaugh.
Rev.Sci.Instrum.(USA), Vol.35, No.10.1310-3 (Oct.1964).

A new technique has been developed for measuring small conduction currents due to microsecond duration pulses of voltage; the method is equally applicable to longer duration pulses. It uses a charge-storing technique in which the conduction current through the sample is integrated on a capacitor whose voltage is measured after the high voltage pulse is terminated. The sensitivity of the method can be increased by integrating charge over a large number of pulses. With high voltage pulses as short as 1 μsec, the technique enables one to measure currents of 1 μA with an accuracy of about 5%.

PA 67-29845

SW-5. Weiner, J. and L. Roth (Eds.)

"Electrostatic Printing."
Bibliographic Series Number 212, 111 pp.,
The Institute of Paper Chemistry, Appleton, Wis.,
1964.

SW-6. Wells, P. V. and R. H. Gerke

"An Oscillation Method for Measuring the Size of Ultramicroscopic Particles."
J. Am. Chem. Soc. 41, 312-29 (1919).

The usual method of observing the motion of the charged particles is much improved in precision by reversing the direction of the field by means of a rotating commutator. In this way the particle is made to perform repeated oscillations, the amplitude of which may be measured with considerable precision, making possible for the first time the precise measurement of the size of a single ultramicroscopic particle.

The following paper presents some of the results obtained by this method with ultramicroscopic particles suspended in air.

Author

SW-7. Whitby, K. T., B. Y. H. Liu, and C. M. Peterson

"Charging and Decay of Monodispersed Aerosols in the Presence of Unipolar Ion Sources."
Paper presented at the 39th National Colloid Symposium of the ACS Division of Colloid and Surface Chemistry; Clarkson College of Technology, Potsdam, N. Y., June 21, 1965.

SW-8. Whitby, K. T., D. A. Lundgren, and C. M. Peterson

"Homogeneous Aerosol Generators."
Int. J. Air Water Poll. 9, 263-77 (1965).

SW-9. Whitby, K. T. and C. M. Peterson

"Electrical Neutralization and Particle Size Measurement of Dye Aerosols."
Ind. and Eng. Chem. Fund. 4, No. 1, 66-72 (Feb. 1965).

SW-10. White, H. J.

"Industrial Electrostatic Precipitation."
376 pp., Addison-Wesley Publishing Co., Reading, Mass., 1963.

SW-11. Wilson, H. F., R. F. Janes, and E. J. Campan

"Electrostatic Charge Effects Produced by Insecticidal Dust."
J. Econ. Entomology 37, 651-5 (1944).

SY-1. Yamamoto, K.

"On the Positive Column of Electrical Discharge Without Walls." (in English) Memoirs of the Faculty of Engineering, Nagoya University 2, No. 2, 74-98 (Oct. 1950).

SY-2. Yurkstas, E. P. and C. J. Meisenzehl

N64-33069 Rochester U., N.Y. Radiation Chemistry and Toxicology Div.
SOLID HOMOGENEOUS AEROSOL PRODUCTION BY ELECTRICAL ATOMIZATION
Edward P. Yurkstas and Charles J. Meisenzehl. 30 Oct. 1964. 42p. refs.
(Contract W-7401-ENG-49)
(UR-652)

This report describes research into the generation of solid homogeneous aerosols from a source producing uniform, charged droplets from liquid solutions by electrical atomization. The process involves the ejection of the material from a capillary and its disruption in air or other gaseous medium by the application of an electrical field to the material. The development of the method together with the mechanism for uniform droplet and particle formation, the relationships involving the physiochemical properties of the source and the material to be ejected, along with consideration for stable and continuous production of the aerosol, are discussed.

N64-33069, 24-11

SY-3. Yutkin, L. A. and L. I. Gol'tsova

N64-22649 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROHYDRAULIC METHOD OF FEEDING AND ATOMIZING LIQUID FUELS AND OTHER LIQUIDS AND DEVICE FOR ITS ACCOMPLISHMENT
L. A. Yutkin and L. I. Gol'tsova. 3 Jun. 1963. 7 p. Transl. into ENGLISH from Soviet Patent no. 119403, 20 Jan. 1951. p. 1-3.
(FTD-TT-63-478/1+2; AD-412975)

The proposed method of feeding and atomizing liquids and the device for this purpose are based on the complex action of a single electrohydraulic impact that occurs on dischargers in a volume of liquid inside a special device, which is used for supplying, atomizing, and pumping a new portion of the liquid. This device is in the form of a chamber, consisting of a hollow space and having one end closed by a movable piston. There is a channel at the inlet to the chamber; this channel is bent in the form of many elbows through which liquid is fed into the chamber. The purpose of the channel is to buffer the shock impulse that is traveling in the direction of the feeding reservoir. Through an analogously designed channel, the liquid constantly flows out of the chamber. A long nozzle for ejecting the liquid is located at the other end of the chamber.

N64-22649, 15-07

SZ-1. Zawidzki, T. W.

"Vonnegut's Spraying Fountain, An Oxygen-pressure Dependant Chemica Process."
Z. Angew. Math. Phys. 14, 441-8 (1963).

CA 60-2337g

SZ-2. Zebel, G.

"Deposition of Aerosol Flowing Past a Cylindrical Fiber in a Uniform Electric Field."
Paper presented at the 39th National Colloid Symposium of the ACS Division of Colloid and Surface Chemistry; Clarkson College of Technology, Potsdam, N. Y., June 21,1965.

SZ-3. Zeleny, J.

"Electrical Discharges from Pointed Conductors."
Phys. Rev. 16, 102-125 (1920).

SURVEY OF GOVERNMENT SPONSORED PROJECTS

GC-1. A. D. Little, Inc.
Author Unknown
Letter Report
Contract No. DA 18-108-405 CML 852

"Research on Electrical Phenomenia Associated With Aerosols"

Oct. 24, 1962

GC-2. A. D. Little, Inc.

AD-299 716 Div. 3, 25
(TISTR/SJR) OTS price $6.60

Arthur D. Little, Inc., Cambridge, Mass.
ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS.
Final rept., 15 June 60-15 Feb 62,
by Bernard Vonnegut, D. Read Moffett and others.
15 Mar 62, 60p.
(Contract DA 18-108-405-cml-852)
Unclassified report

DESCRIPTORS: *Chemical warfare agents, *Aerosols, Atomization, Sprays, Electrostatics, Surface tension, High-speed photography, Vapor pressure, Electrical properties.

TAB U63-3-1

GC-3. A. D. Little, Inc.
Doyle, A. W.
Letter Report
Contract No. DA 18-108-405 CML 852

"Research on Electrical Phenomena Associated With Aerosols"

Feb. 19, 1962

GC-4. A. D. Little, Inc.
Doyle, A. W.
Letter Report
Contract No. DA 18-108-405 CML 852

"Research on Electrical Phenomena Associated With Aerosols"

Dec. 29, 1961

GC-5. A. D. Little, Inc.
Author Unknown
Letter Report
Contract No. DA 18-108-405 CML 852

"Research on Electrical Phenomena Associated With Aerosols"

Dec. 21, 1961

GC-6. A. D. Little, Inc.
Doyle, A. W.
Letter Report
Contract No. DA 18-108-405 CML 852

"Research on Electrical Phenomena Associated With Aerosols"

Nov. 8, 1961

GC-7. A. D. Little, Inc.

AD-274 247 Div. 25, 3
(TISTP/TL) OTS price $1.60

Little, Arthur D., Inc., Cambridge, Mass.
RESEARCH IN ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS.
Quarterly rept. no. 5, 15 July-15 Oct 61,
by Bernard Vonnegut, Arnold W. Doyle, and D. Read Moffett. 15 Oct 61, 16p. incl. illus.
(Contract DA 18-108-405-cml-852)
Unclassified report

DESCRIPTORS: (*Electric fields phenomena associated with *Aerosols, Electrons, *Particles.) (*Drops, Evaporation, Voltage, Water, Surface tension, Electrical properties, Electrostatic precipitation.) (Spray nozzles, Atomization, Scattering.)

The fate of charge on a charged volatile particle was investigated. Charged droplets were held suspended in an electric field and allowed to evaporate. Charge and mass were measured as a function of time. Charged water drops evaporate until the electrical forces on the surface are equal to the surface tension forces at which time the droplets disrupt to eject a number of small highly charged droplets. The fraction of charge and mass lost with each ejection and the effect of maximum charging on evaporation rate of a drop are discussed.

TAB U62-3-1

GC-8. A. D. Little, Inc.

AD-260 746 Div. 25, 4, 7
(8 Aug. 61) OTS price $1.60

Little, Arthur D., Inc., Cambridge, Mass.
RESEARCH IN ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS.
Quarterly rept. no. 3, 15 Jan-15 Apr 61,
by Bernard Vonnegut, Arnold W. Doyle, and Philip M. Sliney. 21 July 61. 12p. incl. illus. table.
(Contract DA 18-108-405-cml-852)
Unclassified report

DESCRIPTORS: Ions, *Electrical properties, Drops, *Aerosols, High speed photography, Electrostatic precipitation, Production, Spark shadowgraph photography, Electrostatics, Spectrographic analysis, Instrumentation, Particles, Velocity, Particle trajectories, Atomization.

An ion spectrometer was built to measure the mobilities of charged aerosols. Mobilities were measured for particles down to 0.3 microns in diameter. Difficulties were encountered with the smaller particles; however, large particles are easily handled. The electrical atomization of organic liquids was studied. Particle size at low voltages and low drop frequency was seen to vary as the square root of surface tension. At high voltages low electrical conductivity can strongly influence the atomization. The susceptibility of a liquid to submicron atomization at higher voltages was found to be dependent on electrical conductivity. Charge per drop for a given drop size was found to be constant. Polarity and capillar diameter do not have a strong influence on the atomization process over the ranges investigated.

TAB U61-4-1

GC-9. A. D. Little, Inc.

AD-266 563 Div. 3, 25, 4
(TIPTH/EJH) OTS price $2.60

Little, Arthur D., Inc., Cambridge, Mass.
RESEARCH IN ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS,
Quarterly rept. no. 4, 15 Apr-15 July 61,
by Bernard Vonnegut, Arnold W. Doyle, and D. Read Moffett. 15 July 61, 22p. incl. illus. tables.
(Contract DA 18-108-405-cml-852)
Unclassified report

DESCRIPTORS: (*Aerosols, Particles, *Drops, Electrical properties, Vapor pressure, Surface tension Production, Scattering.) (Surfaces, Electric fields, Electrostatic precipitation.) (Test equipment, Aerosol generators, Spray nozzles.) (Liquids, Octanoic acids, Phthalates, Atomization.)

Results of experiments on the charging of particles by spraying them against solid surfaces are presented. Large differences in charging characteristics were exhibited by various liquids. The effect of charge on the vapor pressure of small particles was evaluated for maximum charging levels. At maximum charge the electrical forces on a droplet are equal and opposite to the surface tension forces; the vapor pressure over a small drop is equal to that over a plane surface. This reduction in vapor pressure is important only for small drop sizes. The deposition of charged particles on small grounded objects was considered. Two geometries were analyzed to show that in spite of low average electric fields there can be a considerable intensification of the field around small grounded objects. As a result charged aerosols will be selectively deposited on these targets.

TAB U62-1-4

GC-10. A. D. Little, Inc.

AD-252 350 Div. 25, 4, 7
(16 Mar 61)

Little, Arthur D., Inc., Cambridge, Mass.
RESEARCH IN ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS,
by Bernard Vonnegut, Arnold W. Doyle, and Philip M. Sliney. Quarterly rept. no. 2, 16 Oct 60-15 Jan 61, 28 Feb 61, 23p. incl. illus. tables.
(Contract DA 18-108-405-cml-852)
Unclassified report

DESCRIPTORS: *Electrical properties, Drops, *Aerosols, High speed photography, Electrostatic precipitation, Production, Spark shadowgraph photography, Electrostatics,

A study of an electrostatic mechanism for droplet production has been continued. High-speed motion pictures were taken which show the intricacies of the droplet production. Four different types of electrostatic droplet production are described. Generation is independent of polarity. Geometry is important and effect is illustrated. Quantitative values of drop frequency and drop electrical properties are given. Drop generation is very sensitive to liquid flow rate and a constant flow apparatus is shown. A dark field, high-intensity, short-duration spark photographic technique is described and photos of electrostatic smoke formation are presented. Neutral droplets down to 20 microns diameter were produced with a vibrational technique. Submicron sizes can be produced with an impaction mechanism instead of vibration.

TAB U61-2-3

GC-11. A. D. Little, Inc.

AD-244 581 Div. 25
(24 Oct 60)

Little, Arthur D., Inc., Cambridge, Mass.
RESEARCH IN ELECTRICAL PHENOMENA ASSOCIATED WITH AEROSOLS, by Bernard Vonnegut, Arnold W. Doyle and Philip K. Sliney. Quarterly rept. no. 1, 15 July-15 Oct 60. 14 Oct 60, 17p. incl. illus.
(Contract DA 18-108-405-cml-853) Unclassified report

Descriptors: Electrostatic precipitation; Drops; Surface tension; Viscosity; Conductivity; Production; Aerosols; Electrostatic precipitators*; Electrostatic fields*.

Qualitative measurements were made on the production of droplets at frequencies up to several hundred cps from the tip of a metal capillary maintained at d-c voltages up to 20 kv. The frequency of drop production is extremely sensitive to voltage, increasing as much as tenfold with a 10% increase in voltage. The voltage required to produce a given size of droplet varies as the square root of the surface tension. The rate of droplet production for aqueous solutions is relatively insensitive to the viscosity and electrical conductivity of the liquid. The droplets coming off the electrode are highly charged, and the surface density of charge appears to vary inversely as the radius. The charge on the droplets can be reduced to any desired value or completely removed by passing them through conductive air produced by an ion source such as radioactivity or an open flame.

TAB U60-4-6

GC-12. A. D. Little, Inc.
Author Unknown
Final Report
Contractor: AFCRC, Geophysics Research Directorate

"A Study of the Techniques for Measuring the Concentration of Space Charge in the Lower Atmosphere"

Jan. 31, 1958

GC-13. Aerojet-General Corp.
Berg, T. G. O. and W. J. Flood
Report No. 0395-04(14)SP

"Investigation of Electrification of Powders in Flow Through Tubes and Nozzles II. Charge Analysis of Deagglomerated Powders"

Nov. 1963

GC-14. Aerojet-General Corp.
Berg, T. G. O. and L. E. Avis
Report No. 0395-04(13)SP
Contract No. DA 18-108-405 CML 829

"Exploratory Experiments on Kinetics and Mechanisms of Comminution"

Oct. 1963

GC-15. Aerojet-General Corp.
Berg, T. G. O. and M. J. Stansbury
Report No. 0395-04(12)SP
Contract No. DA 18-108-405 CML 829

"Investigation of the Force of Adhesion Between Powder Particles II. Plexiglas Powder."

Oct. 1963

GC-16. Aerojet-General Corp.

N65-12221# Aerojet-General Corp., Downey, Calif. Ordnance Div.
INVESTIGATION OF ELECTRIFICATION OF POWDERS IN FLOW THROUGH TUBES AND NOZZLES. I: A CHARGE ANALYZER
T. G. Owe Berg, G. C. Fernish, and W. J. Flood 3 Jun. 1963
45 p refs
(Contract DA-18-108-405-CML-829)
(Rept.-0395-04(08)SP; AD-449189)

As a part of an investigation of the electrification of powders in flow through tubes and nozzles, a charge analyzer has been designed, constructed, and tested. The charge analyzer has two electrodes at ±1000 volts with respect to ground. At a stationary state the current from each electrode is equal to the rate of deposition of charge. The two currents are recorded and integrated with a planimeter. The electrodes are weighed on a microbalance for determination of the amount deposited. The nozzle is located at one end of the pair of electrodes. Experiments have been conducted with several airborne powders, in the range 1μ to 30μ of particle diameter, flowing through a hypodermic needle of 0.8-mm diameter and 3-ft length of flow rates between 50 and 500 cc/mm. The average positive charge, the average negative charge, and the average absolute charge are proportional to the square of the flow rate. The charge is acquired in friction between the powder particles and a deposit on the tube wall.

N65-12221, 02-23

GC-17. Aerojet-General Corp.
Berg, T. G. O.
Report No. 0395-04(07)SP
Contract No. DA 18-108-405 CML 829

"Homogeneous Condensation of Vapors"

May 1, 1963

GC-18. Aerojet-General Corp.
Berg, T. G. O. and D. C. George
Report No. 0395-04(06)SP
Contract No. DA 18-108-405 CML 829

"High-Speed Photography of Condensation of Water Vapor in an Expansion Chamber"

April 1963

GC-19. Aerojet-General Corp.
Berg, T. G. O. and T. A. Gaukler
Report No. 0395-04(05)SP
Contract No. DA 18-108-405 CML 829

"The Mechanism of the Tribo Effect III. The Effect of the Humidity of the Air."

March 1963

GC-20. Aerojet-General Corp.
Berg, T. G. O., M. J. Hunkins, and M. J. Stansbury
Report No. 0395-04(04)SP
Contract No. DA 18-108-405 CML 829

"Investigation of the Force of Adhesion Between Powder Particles"

March 1963

GC-21. Aerojet-General Corp.
Berg, T. G. O., et al.
Bimonthly Prog. Rpt. 0395-04(03)BP (May/June 1962)
Contract No. DA 18-108-405 CML 829

"Research Study on Dissemination of Solid and Liquid Agents."
pp. 57-74 on "Electrostatic Studies"

July 12, 1962

GC-22. Aerojet-General Corp.
Author Unknown
Progress Report No. 0395-04(02)BP (March/April 1962)
Contract No. DA 18-108-405 CML 829

"Research Study on the Dissemination of Solid and Liquid Agents"

May 16,1962

GC-23. Aerojet-General Corp.
Anderson, W. H., et al.
Progress Report No. 0395-04(01)BP (Jan/Feb. 1962)
Contract No. DA 18-108-405 CML 829

"AGC Research Study on Dissemination of Solid and Liquid Agents"

Feb. 1962

GC-24. Aerojet-General Corp.
Berg, T. G. O. and M. J. Hunkins
Spec. Rpt. No. 0395-04(01)SP
Contract No. DA 18-108-405 CML 829

"Effect of Charge on Coalescence of Sodium Chloride Crystals"

Feb. 1962

GC-25. Aerojet-General Corp.
Anderson, W. H., et al.
Summary Report No. 0395-02(11)FP (Jan. 1960-Dec. 1961)
Contract No. DA 18-108-405 CML 829

"Research Study on the Dissemination of Solid and Liquid Agents"

Jan. 29, 1962

GC-26. Aerojet-General Corp.
Berg, T. G. O., et al.
Quarterly Prog. Rpt. No. 0395-04(02)QP (Oct./Dec. 1962)
Contract No. DA 18-108-405 CML 829

Title Unknown

Jan. 9, 1962

GC-27. Aerojet-General Corp.
Berg, T. G. O.
Report No. 0395-03(10)SP
Contract No. DA 18-108-405 CML 829

"The Mechanism of Adhesion Between Solid Aerosol Particles"

Dec. 29, 1961

GC-28. Aerojet-General Corp.
Anderson, W. H., et al.
Prog. Rept. No. 0395-02(09)BP (Sept./Oct. 1961)
Contract No. DA 18-108-405 CML 829

Title Unknown

Nov. 15, 1961

GC-29. Aerojet-General Corp.
Berg, T. G. O., G. C. Fernish, and M. J. Hunkins
Report No. 0395-03(08)SP
Contract No. DA 18-108-405 CML 829

"Electrostatic Charging of Men and Women in Various Clothing"

Nov. 1961

GC-30. Aerojet-General Corp.
Author Unknown
Prog. Rpt. No. 0395-02(06)BP (May/June 1961)
Contract No. DA 18-108-405 CML 829

Title Unknown

July 26, 1961

GC-31. Aerojet-General Corp.
Berg, T. G. O.
Report No. 0395-50(05)SP
Contract No. DA 18-108-405 CML 829

"The Electrification of Dripping Drops"

July 6, 1961

GC-32. Aerojet-General Corp.
Berg, T. G. O.
Report No. 0395-50(04)BP
Contract No. DA 18-108-405 CML 829

"Dissemination and Use of CW Agents"

July 3, 1961

GC-33. Aerojet-General Corp.
Berg, T. G. O. and N. Brunetz
Report No. 0395-50(03)SP
Contract No. DA 18-108-405 CML 829

"Behavior of Charged Particles on Glass Slides"

July 1961

GC-34. Aerojet-General Corp.
Anderson, W. H., et al.
Prog. Rpt. No. 0395-02(05)BP (March/April 1961)
Contract No. DA 18-108-405 CML 829

"Research Study on Dissemination of Solid and Liquid Agents"

May 23, 1961

GC-35. Aerojet-General Corp.
Berg, T. G. O.
Report No. 423-2
Contract No. DA 18-108-405 CML 829

"Dissemination and Use of CW Agents"

May 2, 1961

GC-36. Aerojet-General Corp.
Berg, T. G. O. and G. C. Fernish
Report No. R-445
Contract No. DA 18-108-405 CML 829

"Mechanism of Coalescence of Liquid Drops"

May 1961

GC-37. Aerojet-General Corp.
Berg, T. G. O.
Report No. R-444
Contract No. DA 18-108-405 CML 829

"The Mechanism of the Tribo Effect"

April 1961

GC-38. Aerojet-General Corp.
Berg, T. G. O.
Final Report No. R-410
Contract No. DA 18-108-405 CML 829

"Investigation of Specific Tasks in Dissemination and Use of CW Agents"

March 17, 1961

GC-39. Aerojet-General Corp.
Berg, T. G. O.
Report No. R-423-1 (Sept./Nov. 1960)
Contract No. DA 18-108-405 CML 829

"Dissemination and Use of CW Agents"

Feb. 28, 1961

GC-40. Aerojet-General Corp.
Berg, T. G. O.
Bimonthly Prog. Rept. No. R-385-3 (Oct./Nov. 1960)
Contract No. DA 18-108-405 CML 829
Confidential Report

"Research Study of the Dissemination of Solid and Liquid Agents"

Dec. 16, 1960

GC-41. Aerojet-General Corp.
Zernow, et al.
Progress Report No. R-385-2 (Aug./Sept. 1960)
Contract No. DA 18-108-405 CML 829

Title Unknown

Oct. 15, 1960

GC-42. Aerojet-General Corp.
Hendel, et al.
Progress Report No. R-391
Contract No. DA 18-108-405 CML 829

Title Unknown

Aug. 29, 1960

GC-43. Aerojet-General Corp.
Zernow, et al.
Progress Report No. R-385-1 (June/July 1960)
Contract No. DA 18-108-405 CML 829

Title Unknown

Aug. 22, 1960

GC-44. Aeroprojects, Inc.
Author Unknown
Progress Report No. 51
Contract No. DA 18-064-404 CML 94

"Electrification"

Issue date unknown.

GC-45. AFCRC, Geophysics Research Directorate
Ghosh, S. N., W. F. Sheridan, J. A. Dillon, and H. D. Edwards
Geophysical Research Paper No. 48
Contract No. AFCRC - TR 56-205

"A Review of Charge Transfer Processes in Gases"

July 1955

GC-46. Argonne National Laboratories
Katz, H. M.
Report No. ANL-5725
Contract No. W-31-109 eng 38

"Studies of Particle Size Distribution in Fluidized Beds"

May 1957

GC-47. Associated Nucleonics, Inc.

AD-285 945 Div. 3
(TISTP/WM)

Associated Nucleonics, Inc., Garden City, N. Y.
FLUID BED COLLECTION AND DISSEMINATION STUDY,
by Robert Herbert. 31 Aug 62, 1v. incl. illus. tables, 15 refs. (Rept. no. AN-139)
(Contract DA 18-064-cml-2758)
Unclassified report

No automatic release to foreign nationals.

DESCRIPTORS: *Aerosols, *Powders, *Collecting methods, *Sand.

The possibility of using a fluidized sand bed for collecting and for disseminating fine powders was investigated. The powders studied were Micro-Cel, Cab-O-Sil, flyash, and SM Simulant. The bed contained sand 20 to 30 mesh in size. It was found that a mechanically fluidized sand bed was unfeasible for collecting airborne fine particles. In the dissemination studies performed in a 3-inch diameter column, a gas fluidized sand bed alone permitted only partial mixing with a large fraction of the powder feed short-circuiting the bed inside bubbles of the fluidizing air. Mechanical oscillation did not help. Excellent mixing was obtained with the addition of rotating mixing blades, but the generation of electrostatic charges caused immediate re-agglomeration of the particles. Less re-agglomeration was noted with electrically grounded equipment. Relatively, the best de-agglomerating performance was obtained with no sand present. Dissemination is not recommended. Fine particles with high angles of repose were shown capable of flowing freely with gravity from flat bottomed bins by introducing an extended nozzle at the discharge hole, and of flowing against gravity by piston-like movement through small diameter tubes.

TAB U63-1-2

GC-48. AEC
Author Unknown
Report No. NYO-4615

"Mechanics in Electrostatic Filtration of Aerosols with Fixed and Fluidized Granules"

Aug. 31, 1958

GC-49. AEC
Report No. TID-7551

"Fifth AEC Air Cleaning Conference"

Harvard Air Cleaning Laboratory, June 24-27, 1957. 159 pp.

Report Issued April 1958.

GC-50. Chemical Defence Exper. Estab. (Porton)

AD-337 252L Div. 3/7
(TISTB/WA)

Chemical Defence Experimental Establishment (Gt. Brit.).
DENSITY AND STRUCTURE OF SOME PARTICULATE AGGREGATES (U),
by B. R. Stone and W. R. Lane. 6 Feb 63, 22p.
CDEE PTP844 Confidential report

Notice: Only government agencies may request from DDC. Others request approval of British Ministry of Aviation, via the appropriate channels.

Descriptors: (*Aerosols, Particle size), (*Aerosols, Structural properties), Density Velocity, Electrons, Bacterial aerosols, Electrical properties (U)

TAB U63-4-2

GC-51. Chemical Defence Exper. Estab. (Porton
Burbage, AMR
Porton Note No. 249

"An Investigation of the Relative Mass of Charged Particles in a Thermally-Generated Sub-Micron NaCl Cloud"

Oct. 30, 1962

GC-52. Chemical Defence Exper. Estab. (Porton)
Author Unknown
Tech. Paper (R)35

"Adhesion of Spherical Particles to Plane Surfaces"

April 7, 1961

GC-53. Chemical Defence Exper. Estab. (Porton)
Gillespie, T.
Tech. Paper 289

"The Effect of the Electric Charge Distribution on the Ageing of an Aerosol"

June 26, 1952

GC-54. Chemical Defence Exper. Estab. (Porton)
Author Unknown
Tech. Paper 249

"The Shatter of a Small Quantity of Liquid by Means of a Spark Discharge"

July 19, 1951

GC-55. CRDL
Author Unknown
Final Tech. Rept. No. CRDL 550-Ir-5/FTR
Contract No. DA 91-591 EUC 1664

"Ionization Equilibrium in Heterogeneous Aerosols"

Aug. 2, 1962

GC-56. CRDL

AD-294 639 Div. 7
(TISTR/EJH) OTS price $2.60

Army Chemical Research and Development Labs., Army Chemical Center, Md.
DISSEMINATION OF AEROSOLS BY ELECTROSTATICS, by Roy E. Shaffer. Aug 62, 22p. incl. illus. table, refs. (Rept. no. CRDLR 3141)
Unclassified report

DESCRIPTORS: *Aerosols, *Electrostatics, *Chemical warfare agents, Resistance, Electrical properties, Powders, Electric fields, Liquids, Munitions, Electric discharges, Drops, Scattering.

The objectives of the investigation described were: (1) to study the electrostatic properties of certain presized solids to determine whether they could be used to enhance the dissemination efficiency of powdered solids, and (2) to study the aerosolization of liquids by electrostatic means. Present work has been confined to preliminary studies in an attempt to ascertain the most practical and fruitful approaches to the problem of electrostatic dissemination. The principle of electrostatic precharging as a means to increase dissemination efficiency of finely divided (presized) solids shows promise. Application of the principle to chemical munitions is, however, limited to those compounds having high electrical resistance and by the development of techniques to eliminate or reduce electrical discharge. Although the breakup of liquids into fine aerosols by strong electrical fields is technically feasible and requires low energy input, its application to munitions is doubtful at this time because of design problems.

TAB U63-2-2

GC-57. CRDL
Cutler, M.
Tech. Memo 15-50

"Second Coordinating Conference of BW-CW Dissemination Research Contracts"

Oct. 10, 1961

GC-58. CRDL (Ft. Detrick, M. D. Division)
Author Unknown
Tech. Prog. Rept. (Task 4B04-14-030-03. Subtask III - I.)
Project No. 4B04-14-030 (Jan.-June 1960)

"New Techniques for Dissemination"

Issue date unknown.

GC-59. CRDL
Author Unknown
Report No. 60-21
Contract No. CWL 550-2376

"Soviet R/D Applicable to Aerosol and Spray Dissemination of Chemical and BW Agents"

April 18, 1960

GC-60. CRDL

AD-306 196 Div. 3

Chemical Warfare Labs., Army Chemical Center, Md.
SYMPOSIUM VIII. VOLUME I. SPRAY DISSEMINATION OF AGENTS, CONDUCTED BY U.S. ARMY CHEMICAL WARFARE LABORATORIES 4, 5 and 6 MARCH AT ARMY CHEMICAL CENTER, MARYLAND. July 58, 158p. incl. illus. table (CWL special pub. no. 2) Unclassified report

Contents:
Principle of balanced stresses and the mechanical formation of aerosols, by W. E. Ranz
Breakup of liquid droplets, thickened and unthickened, by James D. Wilcox
The aerodynamic breakup of droplets, by John W. Corcoran
Impaction efficiency of aerosol particles, by S. J. Ingram
Evaporation of liquid droplets falling a cloud, by Albert Pfeiffer
Travel of droplets in turbulent stream, by Gabrielle Ascot
Models for computing contamination expected from aircraft spray, by John Rosinski, Richard H. Snow, and Fred B. Smith
Techniques for the determination of droplet sizes in spray, by A. L. Woolridge
Development of a camera to photograph high-speed particles, by John A. Blackley and associates
Dispersion vs diffusion processes, by William G. Tank
(See also AD-115 835, AD-304 400)

TAB U59-8

GC-61. CRDL
Gordieyeff, V. A.
Tech. Report No. CWLR 2051
AD-107 915

"Adsorption of Vapors on Solid Aerosols (Dusts)"

Aug. 17, 1956

GC-62. CRDL
Author Unknown
Report No. CWL 550 H-2

"Dispersal of Liquids into Monodisperse Aerosols by Means of Electrical Atomization. I."

Jan. 1956

GC-63. CRDL
Macy, R. (Chairman)
Report No. ETF 158-29

"Report of Symposium V. Aerosols"

June 22-23, 1953

GC-64. CRDL
Author Unknown
Report No. ETF 158-24/3

"Investigation of the Aggregation of Fine Particle Matter Suspended in Air"

March 14, 1951

GC-65. CRDL
Goldenson, J. and J. D. Wilcox
Report No. TCR 78

"Carrier Dusts for Toxic Aerosols. II. Preliminary Dispersal Tests"

Jan. 1951

GC-66. CRDL
Wilcox, J. D. and J. Goldenson
Report No. TCR 66

"Carrier Dusts for Toxic Aerosols. I. Preliminary Survey of Dusts."

Oct. 1950

GC-67. Columbia University
Drozin, V. G. and D. de Deo
Report No. NYO-4657
AEC Contract No. AT (30-1) - 1434

"Size Distribution in Aerosols Determined by Settling of Charged Particles"

Aug. 31, 1955

GC-68. Cornell Aeronautical Lab., Inc.

AD-412 361 Div. 25, 9
(TISTP/MFA) OTS price $2.60

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EXPERIMENTS ON SHOCK RELAXATION IN PARTICLE SUSPENSIONS IN A GAS AND PRELIMINARY DETERMINATION OF PARTICLE DRAG COEFFICIENTS,
by George Rudinger. July 63, 17p. Proj. SQUID; TR CAL90P
Proj. NR098 038
Unclassified report

In cooperation with Virginia U., Charlottesville. Contract Nonr362200.

Descriptors: (*Shock waves, Theory), (*Shock tubes, Particles), Viscosity, Density, Pressure, Velocity, Electrostatics, Fluid flow, Drag, Particle trajectories.

A shock-tube technique is used to investigate the flow conditions behind a shock wave propagating through a suspension of small solid particles in a gas. With the aid of a particle injector system, the driven section of the shock tube can be filled with a reasonably uniform suspension of known composition. The particles are rapidly accelerated behind a shock, and their motion is recorded by streak photography; in addition, the shock velocity and the pressure variations at one point of the test section are obtained. The flow conditions in the relaxation zone behind the shock wave can be derived from these measurements and the data are used to obtain the relationship between drag coefficient and particle Reynolds number. In the experiments conducted so far, 29-micro particles were used, and the particle Reynolds numbers were below 300. All data are well correlated by C sub D = 6000/Re1.7. This relationship deviates strongly from conventionally used correlations, and it is suspected that electric charges on the particles may cause such a discrepancy if the particles are as small as those used in the present experiments. The actual mechanism of the effect has not yet been explained.

TAB U63-4-4

GC-69. Defence Research Board of Canada, Suffield Experimental Station
Gillespie, T. and G. O. Langstroth
Suffield Tech. Paper No. 12

"An Instrument for Determining the Electric Charge Distribution in Aerosols"

Feb. 14, 1952

GC-70. Del Electronics Corp.
Cravitt, S., et al.
Semiannual Prog. Rept. No. NYO-9678 (Feb.-Aug. 1963)
Contract No. AT(30-1)2363

"Stratospheric Monitoring Program"

Sept. 18, 1963

GC-71. Del Electronics Corp.
Cravitt, S., et al.
Semiannual Prog. Rept. NYO-9677 (July 1962-Jan. 1963)
Contract No. AT(30-1)2363

"Stratospheric Monitoring Program"

March 15, 1963

GC-72. Del Electronics Corp.
Cravitt, S., P. Lilienfeld, and A. Foldes
Quarterly Prog. Rept. No. NYO-9676 (April-July 1962)
Contract No. AT(30-1)2363

"Stratospheric Monitoring Program"

Jan. 13, 1963

GC-73. Del Electronics Corp.
Cravitt, S., P. Lilienfeld, and H. Weber
Summary Prog. Rept. No. NYO-9675 (Feb. 1961-April 1962)
Contract No. AT(30-1)2363

"Stratospheric Monitoring Program"

Sept. 10, 1962

GC-74. Del Electronics Corp.
Cravitt, S., P. Lilienfeld, and H. Weber
Bimonthly Prog. Rept. No. NYO-9674 (Dec. 1960-Jan. 1961)
Contract No. AT(30-1)2363

"Stratospheric Monitoring Program"

Aug. 22, 1962

GC-75. Harry Diamond Labs.

AD-299 259 Div. 8, 6
(TISTP/JW) OTS price $4.60

Harry Diamond Labs., Washington, D. C.
ELECTRETS. PART I. A STATE OF THE ART SURVEY,
by Virginia Ann Johnson. 31 Aug 62, 52p.
(Rept. no. TR-1045)
(DA proj. 5B97-01-005, HDL proj. 30300)
Unclassified report

DESCRIPTORS: *Electrets, Dielectric properties, Polarization, Electric currents, Piezoelectric effect.

TAB U63-2-6

GC-76. Dow Chemical Company
Walles, W. E., J. L. Kroon, and J. J. Davies
First Semiannual Report (Aug. 1,1964-Feb. 1, 1965)
Contract No. DA 18-035 AMC 259 (A)

"Research Toward Electrofluidized Aerosols and Chemically Triggered Electrofluidization"

March 22, 1965

GC-77. General Mills Electronics Corp.
Author Unknown
Quarterly Progress Report No. 5
Contract No. DA 18-064 CML 2745

"Dissemination of Solid and Liquid BW Agents"

Nov. 30, 1961

GC-78. General Mills Electronics Corp.
Author Unknown
Quarterly Progress Report 4 (May/June 1961)
Contract No. DA 18-064 CML 2745

"Dissemination of Solid and Liquid BW Agents"

Aug. 10, 1961

GC-79. General Mills. Inc.

AD-415 902 Div. 4
(TISTM/AM) OTS price $16.00

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Final rept. 3 June 60-31 June 63,
by J. H. Nash, G. G. Leiter, A. P. Johnson, D. Stender and H. W. Zeller. 15 Mar 63, 1v.
Rept. 2361
Contract DA18 108 405CML824, Proj. 81524
Unclassified report

Descriptors: (*Powders, Organic materials), (*Organic materials, Powders), Physical properties, Tensile properties, Coatings, Shear stresses, Humidity, Grinders, Adsorption, Gases, Particle size, Density, Theory, Electrostatics, Test method, Data, Equations, Test equipment, Liquids, Sedimentation, Strain gages, Electron microscopy, Albumins, Eggs, Waxes, Crystals.

This is a fundamental study of factors affecting the flow and dispersibility of finely divided organic powders. Most of the investigations pertain to three base powders: saccharin, Carbowax 6000, and Span 60. These powders were chosen to represent crystalline, waxy, and gummy types of powders, respectively. Late in the program, a fourth powder (egg albumin) was added to the list of powders to be investigated. The preparation of powders including grinding, deagglomeration, blending, coating with surface active agents, etc. is discussed. The various tests for measuring physical properties of powders including particle size distribution, shear strength, bulk tensile strength, bulk density, dynamic angle of repose, dispersibility, and electrostatic charge are described. The major studies are: (1) bulk tensile strength tests, (2) effects of humidity on powder properties, (3) effects of antiagglomerant agents on powder properties, (4) mechanism by which Cab-O-Sil functions, (5) effects of surface active agents on powder properties, (6) effects of adsorbed foreign vapors on powder properties, (7) effects of removal of adsorbed gases and vapors, (8) energy required to disperse a powder sample, (9) properties of compacted powders, and (10) egg albumin studies.

TAB U63-4-6

GC-80. General Mills, Inc.

AD-288 249 Div. 4
(TISTM/BRM)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Quarterly progress rept. no. 9, 3 July-3 Oct 62, by J. H. Nash, G. G. Leiter and A. P. Johnson. 31 Oct 62, 47p. incl. illus. tables (GMI rept. no. 2352)
(Contract DA 18-108-405-cml-824)
Unclassified report

No automatic release to foreign nationals.

DESCRIPTORS: *Particles, *Powders, Scattering, Measurement, Aerosols, Shear stresses, Electrostatics, Surfaces.

Samples of finely ground Carbowax 6000 treated with 20 surface active agents representing the 4 main types (non-ionic, anionic, cationic and amphoteric) were tested for shear strength, dispersibility, and electrostatic charge. Shear strength tests indicate all samples, except those treated with Span 60 (non-ionic agent), have lower shear strengths than the control. The 3 samples with lowest shear strength were treated with cationic-type agents. Dispersibility tests indicate amphoteric agents have little or no effect, non-ionic agents a beneficial one, and anionic and cationic agents detrimental effects. Electrostatic charge tests indicate no change in samples treated with non-ionic agents. Samples treated with anionic agents were more negatively charged than the control, and samples treated with cationic agents were about equally divided between positively and negatively charged. Effects of adsorbed acetone and propionaldehyde vapors on properties of saccharin, Carbowax 6000 and Span 60 were investigated. Acetone vapors caused saccharin and Span 60 samples to agglomerate into hard balls. Propionaldehyde vapors had a similar effect on saccharin. Samples not agglomerated were tested for shear strength, dispersibility, and electrostatic charge. The most significant finding was that the dispersibility characteristics of Span 60 are improved by propionaldehyde vapors.

TAB U63-1-4

GC-81. General Mills, Inc.

AD-281 923 Div. 3
(TISTM/GEC)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS
Quarterly progress rept. no. 8, 3 Apr-3 July 62, by J. H. Nash, G. G. Leiter, and A. P. Johnsen. 25 July 62. 37p. incl. illus. tables. 13 refs. (Rept. no. 2315)
(Contract DA 18-108-405-cml-824)
Unclassified report

No automatic release to foreign nationals.

DESCRIPTORS: *Aerosols, *Powders, Particles, Saccharides, Shear stresses, Diffusion, Scattering, Adsorption, Surface properties, Tensile properties, Ionization, Phenols, Additives, Adhesion, Vapors, Organic compounds, Electrostatics, Wetting agents, Chemical warfare agents, Physical properties.

An investigation was made of effects of surface active agents and adsorbed foreign vapors on properties of fine organic powders. Twenty surface active agents representing the four main types (non-ionic, anionic, cationic and amphoteric) were tested to determine their effects on finely ground saccharin. Powder samples treated with various agents were tested for shear strength, dispersibility and electrostatic charge. The most significant finding was the fact that cationic agents definitely improve the dispersibility characteristics of saccharin. The effects of adsorbed phenol vapors on properties of three base powders (saccharin, Carbowax 6000 and Span 60) were investigated. Results indicated that adsorbed phenol vapors have no marked beneficial effects on powder properties. A technique for standardizing the light source on the aerosol decay chamber is described. Particle size analyses using the Whitby sedimentation centrifuge technique were made on samples of the original batch and the new batch of finely ground saccharin.

TAB U62-4-5

GC-82. General Mills, Inc.

AD-275 264 Div. 3
(TISTM/EJK)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Quarterly progress rept. no. 7, 3 Jan-3 Apr 62, by J. H. Nash, G. G. Leiter, and A. P. Johnsen. 3 May 62, 64p. incl. illus. tables (Rept. no. 2276)
(Contract DA 18-108-405-cml-824)
Unclassified report

No automatic release to foreign nationals.

DESCRIPTORS: (*Aerosols, *Powders, Particles, Scattering, *Diffusion, Shear stresses, Physical properties, Density, Tensile properties, Surface properties, Vapors, Adsorption, Electrostatics, Decay, Pressure, Temperature.) (Organic compounds, Saccharides, Benzenes, Sulfimides and Polymers, Ethylenes, Glycols and Stearates.) Additives, Adhesion.

The investigations reported deal mainly with the measurement of physical properties of three base powders (saccharin, Carbowax 6000 and Span 60) containing various amounts of selected anti-agglomerant agents (Cab-O-Sil, Alon-C, P-25 and tri-calcium phosphate). Shear strength, dynamic angle of repose, bulk density, dispersibility and electrostatic charge studies were made. Results indicated that Cab-O-Sil is the most effective anti-agglomerant agent. Investigations were also conducted to determine effect of rate of force application and effect of powder bed thickness on powder shear strength. Results indicated that powder shear is independent of rate of force application over the range 4,740 - 142,000 dynes/sec and is nearly independent of power bed thickness over the range 1.7 - 3.3 mm. Electrostatic charge tests were made on samples of saccharin and Carbowax 6000 treated with eleven different surface active agents. Results were inconclusive.

TAB U62-3-3

GC-83. General Mills, Inc.

AD-271 722 Div. 3
(TISTM/GEC)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Quarterly progress rept. no. 6, 3 Sep 61-3 Jan 62,
by J. H. Nash, G. G. Leiter and A. P. Johnsen. 15 Feb 62, 58p. incl. illus. tables (GMI rept. no. 2256)
(Contract DA 18-108-405-cml-824)
Unclassified report

No automatic release to Foreign Nationals.

DESCRIPTORS: (*Powders, Particles, *Aerosols, Organic compounds, Electrostatics, Additives, Scattering.) (Physical properties, Density, Diffusion, Vapors, Adsorption, Surface properties, Mechanical properties, Tensile properties, Shear stresses, Humidity, Adhesion.) (Saccharides, Sulfimides, Polymers, Ethylenes Glycols, Stearates.) Electron microscopy.

Electrostatic charge analyses were made on samples of the three base powders (saccharin, Carbowax 6000 and Span 60) which had been pre-conditioned at various relative humidities ranging from less than 1 to 75%. A study was made using an electron microscope of the effects of the addition of a small amount of Cab-O-Sil on the properties of Carbowax 6000. The effect of concentration of Cab-O-Sil on properties of the three base powders was investigated by performing bulk density tests and dispersibility

tests. A group of 13 different anti-agglomerant agents was evaluated by conducting shear strength tests on samples of the three base powders containing 1% by weight of each of the agents. The most promising agents were Cab-O-Sil, Alon-C, P-25 and Tri-Calcium Phosphate. The effect of n-butylamine vapors adsorbed on the surface of Carbowax 6000 particles was investigated. It was found that the formation of linear aggregates in an electric field can be completely eliminated by an adsorbed layer of n-butylamine.

TAB U62-2-3

GC-84. General Mills, Inc.
Author Unknown
Letter Progress Report
Contract No. DA 18-108-405 CML 824

"Fundamental Studies of the Dispersibility of Powdered Material"

Dec. 1961

GC-85. General Mills, Inc.
Author Unknown
Letter Progress Report
Contract No. DA 18-108-405 CML 824

"Fundamental Studies of the Dispersibility of Powdered Material"

Nov. 1961

GC-86. General Mills, Inc.

AD-264 961 Div. 3
(TIPSH/LJH) OTS price $5.60

General Mills Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Quarterly progress rept. no. 5, 3 June-3 Sep 61, by J. W. Nash, G. G. Leiter, and A. P. Johnson. 30 Sep 61. 49p. incl. illus. tables (GMI rept. no. 2229)
(Contract DA 18-108-405-eml-824)
Unclassified report

DESCRIPTORS: (*Aerosols, *Particles, Powders, Organic compounds, Additives, Scattering, Diffusion, Theory.) (Powders, *Saccharides or *Ethylenes, *Glycols or *Stearates, Pressure, Density, Humidity, Mechanical properties, Electrostatics.) Test methods, Test equipment.

A technique is described for studying the manner in which local bulk density of a column of powder compressed in a cylinder varies with distance from the compressing piston. Measurements were made on each of the 3 base powders (saccharin, Carbowax 6000 and Span 60). The effect of humidity on properties of the three base powders was investigated by conducting a series of tests including shear strength, disc-lifting, aerosol decay and electrostatic charge analysis on powder samples. Fourteen different deagglomerant agents were evaluated by measuring their shear strength at a compressive load of 5305 dynes/sq cm. Cab-O-Sil had the lowest shear strength of all the agents tested.

TAB U62-1-1

GC-87. General Mills, Inc.

AD-260 740 Div. 3
(8 Aug 61) OTS price $6.60

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS.
Quarterly progress rept. no. 4, 3 Mar-3 June 61, by J. H. Nash, G. G. Leiter and H. W. Zeller. 30 June 61, 54p. incl. illus. tables (Rept. no. 2184)
(Contract DA 18-108-405-eml-824)
Unclassified report

DESCRIPTORS: *Aerosols, Powders, Particles, Organic compounds, Saccharides, Scattering, Tensile properties, Adhesion, Adsorption, Additives, Shear stresses, Electrostatics, Sulfimides, Glycols, Ethylenes, Polymers, Stearates, Fluid flow, Tests.

A technique involving the use of a 2-in.-diam fluid energy mill was devised for blending and deagglomerating powders. A study of average bulk density as a function of plug length and compressive load was made on each of the 3 base powders (saccharin, Span 60, and Carbowax 6000). The effect of removal of adsorbed gases and vapors was investigated by disk-lifting tests on samples of the 3 base powders under normal laboratory conditions and under high vacuum conditions (0.00002 mm Hg). A technique involving stratified layers was devised for the purpose of studying powder displacement during disk-lifting tests. An improved technique for measuring shear strength of powders is described. Aerosol decay tests were made on samples of the same powders on which shear strength measurements were made. A comparison of results indicates that there is little correlation. A theoretical study was made to determine energy expended in dispersing an aerosol. Electrostatic charge analyses were made on aerosols of Span 60 and Carbowax 6000.

TAB U61-4-1

GC-88. General Mills, Inc.

AD-255 484 Div. 3
(8 May 61) OTS price $5.60.

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS,
by J. H. Nash, H. W. Zeller and G. G. Leiter.
Quarterly progress rept. no. 3, 3 Dec 60-3 Mar 61. 31 Mar 61, 47p. incl. illus. tables.
(Rept. no. 2183)
(Contract DA 18-108-405-cml-824)
Unclassified report

DESCRIPTORS: Powders, Particles, *Aerosols, Organic compounds, Saccharides, Scattering, Tensile properties, Mechanical properties, Electrostatics, Tests, Diffusion, Vapors, Additives, Adsorption, Sulfimides, Glycols, Polymers, Ethylenes, Stearates, Fluid flow.

Factors affecting the flow and dispersibility of organic powders in the 2 - 5 micron size range have been the subject of investigation of this study. The tests reported herein were conducted on samples of finely ground saccharin, Carbowax 6000 and Span 60 or on samples of these powders containing various additives. Several different types of tests were conducted including the followings: bulk tensile strength tests, shear strength tests, disc-lifting tests conducted under high vacuum conditions and under laboratory conditions to study effect of removal of adsorbed vapors and gases, tests to determine energy required to disperse an aerosol and electrostatic charge analysis.
TAB U61-3-1

GC-89. General Mills, Inc.

AD-249 913 Div. 3
(31 Jan 61)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS,
by J. H. Nash and G. T. Leiter. Quarterly progress rept. no. 2, 3 Sep-3 Dec 60. 31 Dec 60, 41p. incl. illus. tables (Rept. no. 2148)
(Contract DA 18-108-405-cml-824)
Unclassified report

DESCRIPTORS: Powders, Particles, *Aerosols, Tensile properties, *Biological warfare agents, Tests, Diffusion, Scattering.

Tests were made on samples of finely ground saccharin and Carbowax 6000 and samples of these materials containing various deagglomerant agents. A technique is described for measuring the true bulk tensile strength of powders at various degrees of compression. The technique also makes it possible to determine the distribution of bulk tensile strength throughout the length of a column of compressed powder. It was found that the bulk tensile strength of a powder is an exponential function of the distance from the piston to the fracture plane. The bulk tensile strength of a thin layer of powder immediately below the piston is proportional to the compression load applied to the piston. For a given compressive load, the bulk tensile strength of Carbowax 6000 was highest, saccharin next and zinc cadmium sulfide lowest. Disc lifting measurements were made at three widely different conditions of humidity on plain Carbowax 6000 and on Carbowax 6000 containing 1% by weight tri-calcium phosphate. As the humidity decreases, greater and greater forces are required to lift the discs out of the powders. Equations relating force to disc diameter and powder depth were developed for each powder and for each humidity.

TAB U60-4-5

GC-90. General Mills, Inc.

AD-243 607 Div. 3, 25
(10 Oct 60)

General Mills, Inc., Minneapolis, Minn.
FUNDAMENTAL STUDIES OF THE DISPERSIBILITY OF POWDERED MATERIALS, by J. H. Nash, H. Wm. Zeller, and G. T. Leiter. Quarterly progress rept. no. 1, 3 June-3 Sep 60. 26 Sep 60, 36p. incl. illus. tables (Rept. no. 2112)
(Contract DA 18-108-405-cml-824) Unclassified report

Descriptors: Powders*; Particles; Aerosols*; Solids; Adhesion*; Friction; Tensile properties; Biological warfare agents*; Scattering.

Saccharin is one of the three organic materials tentatively chosen to be included in this investigation. The others are Carbowax 6000 and Span 60. A sample of saccharin was ground in an Alpine impact mill. Microscopic particle size analyses indicated that the count median diameter was reduced from 18.6 to 1.67 microns by grinding. Carbowax 6000 does not lend itself to grinding in an impact mill because of its low melting point. Efforts have been concentrated on devising meaningful and reproducible tests for studying forces between particles and factors affecting dispersibility of powders. They include (1) a technique referred to here as the Disc-Lifting Method for measuring the internal angle of friction and the bulk tensile strength of powders at low degrees of compression, (2) a technique for measuring bulk tensile strength of powders at relatively high degrees of compression, (3) a Tilting Table method for measuring the "adhesive power" of powders, and (4) a centrifuge technique for measuring forces between particles. Most of the measurements were made on two samples of ground saccharin, one containing no additives and one containing 1% by weight Cab-O-Sil. The addition of Cab-O-Sil to saccharin had the effect of increasing the angle of internal friction, reducing the bulk tensile strength both at low and at high degrees of compression and reducing the "adhesive power" of the powder.
TAB U60-4-5

GC-91. Geophysics Corp. of America
Doyle, A. W., et al.
9th Monthly Letter Progress Report
Contract No. DA 18-108 AMC 249(A)

"New Techniques for Dissemination of Chemical Agents"

April 17, 1964

GC-92. Geophysics Corp. of America
Doyle, A. W., et al.
5th Monthly Letter Progress Report
Contract No. DA 18-108 AMC 249(A)

"New Techniques for Dissemination of Chemical Agents"

Dec. 19, 1963

GC-93. Geophysics Corp. of America
Doyle, A. W., et al.
4th Monthly Letter Progress Report
Contract No. DA 18-108 AMC 249(A)

"New Techniques for Dissemination of Chemical Agents"

Nov. 27, 1963

GC-94. Georgia Institute of Technology
Burson, J. H., L. Masironi, and C. Orr
Annual Report, Project A-763 (March 15, 1964-March 14, 1965)
Contract No. DA AMC 18-035-74A

"The Influence of Electrostatic Effects on the Properties of Organic Powders"

April 1, 1965

GC-95. Georgia Institute of Technology
Author Unknown
Final Report
Contract No. DA 18-064-404 CML 88

"Studies and Investigations of Agglomeration and Deagglomeration of Solid Particles"

June 1957

GC-96. Georgia Institute of Technology
Author Unknown
Semifinal Report, Project No. A-233
Contract No. DA 18-064-404 CML 88

"Studies and Investigations of Agglomeration and Deagglomeration of Solid Particles"

June 1956

GC-97. Georgia Institute of Technology
Orr, C., et al.
Quarterly Report No. 2
Contract No. DA 18-064 CML 2570
AD-89 188

"Investigations on the Relation, if any, between Viability and Electric Charges on Airborne Microorganisms or Particles Containing Such Microorganisms."

Dec. 31, 1954

GC-98. Georgia Institute of Technology
Orr, C., et al.
Quarterly Report No. 1
Contract No. DA 18-064 CML 2570
AD-89 187

"Investigations on the Relation, if any, between Viability and Electric Charges on Airborne Microorganisms or Particles Containing Such Microorganisms."

Sept. 30, 1954

GC-99. Georgia Institute of Technology
Orr, C., et al.
Final Report
Contract No. DA 18-064 CML 2379
AD-38 787

"An Investigation of Factors Determining Aggregation of Fine Particle Matter"

June 14, 1954

GC-100. Georgia Institute of Technology
Orr, C., et al.
Quarterly Report No. 3
Contract No. DA 18-064 CML 2379
AD-44 577

"An Investigation of Factors Determining Aggregation of Fine Particle Matter"

March 14, 1954

GC-101. Georgia Institute of Technology
Orr, C., et al.
Quarterly Report No. 2
Contract No. DA 18-064 CML 2379
AD-25 249

"An Investigation of Factors Determining Aggregation of Fine Particle Matter"

Dec. 14, 1953

GC-102. Georgia Institute of Technology
Dallavalle, J. M., C. Orr, and B. Hinkle
Quarterly Report No. 7
Contract No. DA 18-064 CML 490
AD-6 020

"Investigation of Aggregation of Fine Particle Matter Suspended in Air"

March 14, 1953

GC-103. Georgia Institute of Technology
Dallavalle, J. M., C. Orr, and B. Hinkle
Quarterly Report No. 6
Contract No. DA 18-064 CML 490
AD-766

"Investigation of Aggregation of Fine Particle Matter Suspended in Air"

Dec. 14, 1952

GC-104. Georgia Institute of Technology
Author Unknown
Final Report No. ETF 158-24
Contract No. DA 18-064 CML 402

"Investigation of Aggregation of Fine Particle Matter Suspended in Air"

June, 1951

GC-105. Harvard School of Public Health
Dennis, R., et al.
Prog. Rept. No. NYO-4810 (July 1, 1956-June 30, 1957
Contract No. AT(30-1)-841

"Air Cleaning Studies"

June 30, 1959

GC-106. Harvard School of Public Health
Dennis, R., et al.
Prog. Rept. No. NYO-4809 (July 1, 1955-June 30, 1956)
Contract No. AT(30-1)-841

"Air Cleaning Studies"

March 16, 1959

GC-107. Harvard School of Public Health
Anderson, D. M. and L. Silverman
Report No. NYO-4615
Contract No. AT(30-1)841

"Mechanisms in Electrostatic Filtration of Aerosols with Fixed and Fluidized Granules"

Aug. 31, 1958

GC-108. Harvard School of Public Health
Dennis, R.; E. Kristal, and L. Silverman
Report No. NYO-4614
Contract No. AT(30-1)841

"Evaluation of the Electro-PL and Electro-Klean Dust Collectors"

July 21, 1958

GC-109. Harvard School of Public Health
Dennis, R., et al.
Progress Rept. No. NYO-4611 (July 1 1954-June 30, 1955)
Contract No. AT(30-1)-841

"Air Cleaning Studies"

Oct. 15, 1956

GC-110. Harvard School of Public Health
Silverman, L., E. W. Connors, and D. A. Anderson
Report No. NYO-4610
Contract No. AT(30-1)-841

"Electrostatic Mechanisms in Aerosol Filtration by Mechanically Charged Fabric Media and Related Studies"

Sept. 4, 1956

GC-111. Harvard School of Public Health
Dennis, R., et al.
Prog. Rept. No. NYO-4608 (July 1, 1953-June 30, 1954)
Contract No. AT(30-1)-841

"Air Cleaning Studies"

Jan. 15, 1956

GC-112. Harvard School of Public Health
Rossano, A. T. and L. Silverman
Report No. NYO-1594
Contract No. AT(30-1)-841

"Electrostatic Mechanisms in Fiber Filtration of Aerosols"

May 11, 1955

GC-113. Hughes Research Labs.

AD-406 604 Div. 27
(TISTA/LSE)

Hughes Research Labs., Malibu, Calif.
CHARGING AND REMOVAL OF SURFACE-CONDENSED PARTICLES FOR COLLOID PROPULSION,
by Douglas H. Jenbe and Bernard Hornstein.
1963, 9p.
Unclassified report

Presented at AIAA Electric Propulsion Conference, 11-13 Mar 1963, Colorado Springs, Colo.

In cooperation with Thiokol Chemical Corp., Deaville, N. J.

Descriptors: *Electric propulsion, *Ion engines, Accelerators, Particles, Charged particles, Electrostatics, Metal films, Design, Symposia, Colloids.

Work has concentrated on the charging and removal of particles formed by condensing metal vapors on surfaces in vacuum. The necessary apparatus was designed and constructed for charging, accelerating and measuring the electrical properties of charged particles having any charge-to-mass ratio. The apparatus is based on the measurement of the time of flight of charged particles, where the flight is initiated by the application of a high-voltage pulse and completed at a charge detecting device. Maximum detector sensitivity was obtained with an electron multiplier structure as the target. Tests were begun using thin film surfaces on which known particulate deposits (50 A to 500 A size range) were grown. The objective is to determine which conditions of particle formation and of particle removal will lead to the reliable formation of a uniform particle beam within the desired Q/M range of 1000 to 10,000 coulombs per kilogram. Initial electrical tests have indicated particle removal and inferred Q/M values of 1000-2000 coulombs per kilogram. In only two cases, however, have electron microscope examination indicated extensive removal of the particle deposit from the substrate.

TAB U63-3-6

GC-114. IIT Research Institute

AD-340 468 Div. 3/7
(TISTB/WA)

IIT Research Inst., Chicago, Ill.
NONHAZARDOUS DISSEMINATION AND DELIVERY CONCEPTS (U).
Quarterly rept. no. 1, 10 Apr-10 July 63,
by D. K. Werle. July 63, 53p.
Contract DA18 108AMC129A
Confidential report

Descriptors: (*Aerosols, Chemical warfare agnets), Distribution, Effectiveness, Laboratory equipment, Particle spectra, Toxicity, Chromatographic analysis, Storage, Electrostatics, Powders. (U)

A comprehensive literature search has shown that practically all ballistic-deliverable (non-aircraft) nonhazardous dissemination devices are based on pyrotechnic or thermal principles. However, work at CRDL has shown that explosive charges as large as 210 g of PETN can be nonhazardous in a powder-fill device. Therefore it is out contention that explosive dissemination may be both nonhazardous and effective provided a presized free-flowing powder is used. It will be necessary to provide noncaking, free-flowing BZ powder 1 to 10 mu in diameter. Therefore means of measuring and reducing the sintering or Tamman effect in BZ are being examined. Also, experiments for measuring the reducing BZ agglomeration are planned. Explosive dissemination of simulants will be tested experimentally.

TAB U63-4-5

GC-115. IIT Research Institute
Langer, G.
Prog. Rept. No. ARF-3187-10 (Oct. 1-Dec. 1, 1962)
Contract No. AF (11-1)-578

"Progress Report of Electrostatic Classification of Submicron Airborne Particles"

Dec. 1, 1962

GC-116. IIT Research Institute
Langer, G.
Final Report
Contract No. AF 19(604)-2411

"Particle Size Classification by Electrostatic Precipitation"

July 15, 1959

GC-117. University of Illinois
Author Unknown
Tech. Rept. No. 17 - Final Report (COO-1019)
Contract No. AT(11-1)-276

"Factors in the Agglomeration of Solid Aerosol Particles"

Sept. 1, 1962

GC-118. University of Illinois
Johnstone, H. F.
Tech. Rept. No. 16 (COO-1018)
Contract No. AT(11-1)-276

"Factors in the Agglomeration of Solid Aerosol Particles"

March 1, 1959

GC-119. University of Illinois
Dawkins, G. S.
Tech. Rept. No. 15 (COO-1017)
Contract No. AT(11-1)-276

"Electrostatic Effects in the Deposition of Aerosols on Cylindrical Shapes"

March 15, 1958

GC-120. University of Illinois
Kraemer, H. F.
Tech. Rept. No. 12 (COO-1013)
Contract No. AT(11-1)-276

"Properties of Electrically Charged Aerosols"

March 31, 1954

GC-121. University of Illinois
Kraemer, H. F. and W. E. Ranz
Tech. Rept. No. 7 (SO-1008)
Contract No. AT(30-3)-28
39 pp.

"Homopolar Electrification of Aerosols"

Sept. 30, 1952

GC-122. University of Illinois
Ranz, W. E.
Tech. Rept. No. 3 (SO-1004)
Contract No. AT(30-3)-28

"The Impaction of Aerosol Particles on Cylindrical and Spherical Collectors"

March 31, 1951

GC-123. Marks Polarized Corp.
AD-403 536 Div. 7
(TISTE/OHD) OTS price $7.60

Marks Polarized Corp., Whitestone, N. Y.
THE CONVERSION OF HEAT TO ELECTRICAL POWER BY MEANS OF A CHARGED AEROSOL.
Final rept., 1 Feb 62-4 Aug 62.
22 Apr 63, 39p.
Contract NOw62 0644
Unclassified report

Descriptors: *Electric power production, *Energy conversion, Effectiveness, Nozzles, Air, Gas flow, Electric fields, Theory, Condensation, Aerosols, Charged particles.

A new process called the condensation aerosol method for the production of small, charged aerosol particles has been developed for use in the electrohydrodynamic energy conversion process. Using this concept, several generators may be placed in series, each one using the same vapor for aerosol formation as the previous unit. Power densities as high as 30 watts/sq. cm. of nozzle throat area have been obtained with a single stage condensation aerosol type EHD generator. Studies of the aerodynamic behavior of the EHD generator with and without energy extraction were made on a fully instrumented test bench. Measurements of the overall efficiency of the generator including frictional losses were made and are reported herein. The kinetic to electric power conversion efficiency of the generator itself was as high as eighty-five percent. Efforts were made toward designing and building a closed loop system for the generator. A small compressor system for circulating a gas in a closed loop was tested. Calculations were made for the design of a small boiler system for operating a closed loop steam cycle at a few atmospheres pressure.
TAB U63-3-4

GC-124. University of Minnesota
Whitby, K. T., et al.
Final Report
Contract No. USPHS AP00136-02

"Charging and Decay of Monodispersed Aerosols in the Presence of a Unipolar Ion Source."

Sept. 1, 1963

GC-125. University of Minnesota
Whitby, K. T., D. A. Lundgren, and R. C. Jordan
Tech. Report No. 13
USPHS Grant No. S-23 (C-4)

"Homogeneous Aerosol Generators"

Jan. 1961

GC-126. University of Minnesota
Whitby, K. T., A. R. McFarland and D. A. Lundgren
Tech. Report No. 12
USPHS Grant No. S-23

"Generator for Producing High Concentrations of Small Ions"

July 1960

GC-127. New York University

AD-334 219 Div. 12/2
(TISIE/OMD)

New York U. Coll. of Engineering, N. Y.
DIGITALIZED ELECTROSTATIC ACCELEROMETER RESEARCH (U).
Quarterly rept. no. 1, 1 June-31 Aug 62,
by John J. Stelder. 31 Aug 62, 26p. incl. illus.
30 refs.
(Contract DA 36-039-sc-90686, Proj. 3F37-02-001;
Continuation of Contract DA 36-039-sc-84509)
Secret report

DESCRIPTORS: *Accelerometers, *Inertial guidance, Particles, Electrostatic fields, Electrodes, Measurement, Particle accelerators, Mathematical analysis, Electrostatics.

TAB U63-2-3

GC-128. Oak Ridge National Laboratories
Saunders, B. G. and R. L. Quinn
ORNL Report No. 1656
AEC Contract No. W-7405-eng-26

"Electrostatic Precipitator for Measuring Particle Size Distribution in Aerosols"

Feb. 8, 1954

GC-129. University of Pennsylvania

AD-406 990 Div. 25
(TISTP/HFA)

Power Information Center, U. of Pennsylvania, Philadelphia.
PROCEEDINGS OF THE SYMPOSIUM ON ELECTROSTATIC ENERGY CONVERSION.
23 Apr 63, 1v. Rept. no. PIC ELE209 1
Contract DA36 039sc90831
Unclassified report

Descriptors: *Energy conversion, *Electrostatics, Instrumentation, Electrostatic generators, Fluid mechanics, Stability, Electric fields, Cathodes, Capacitors, Design, Fluids, Mercury, Potassium, Sodium, Lithium, Emissivity, Transport properties, Aerosols, Feasibility studies, Charged particles, Nucleation, Symposia, Theory

Contents:
Output power from a self-excited electrostatic generator
Fundamental of EHD power generation
The variable capacitance vacuum insulated generator
Electrostatic generators
The variable capacitance electrostatic generator
A feasibility study of a constant oblique field generator
Slender channel EGD power generation
The charged aerosol generator
High voltage colloidal energy converter
Investigation on particle-type electrostatic generators
Performance criterion for EHD generators

TAB U63-4-1

GC-130. Rand Corp.

AD-254 862 Div. 25, 2
(26 Apr 61)

Rand Corp., Santa Monica, Calif.
THE FORCES BETWEEN CONDUCTING SPHERES IN A UNIFORM ELECTRIC FIELD,
by M. H. Davis. 26 Jan 61, 45p. incl. illus. tables (Research memo. no. RM-2607)
(Contract AF 49(638)700, Proj. Rand)
Unclassified report

DESCRIPTORS: Electrostatics, *Conductors, Electrostatic fields, *Spheres, Clouds, Raindrops, *Electric fields.

The electrostatic boundary value problem of two conducting spheres in a uniform electric field is solved in bispherical coordinates. The spheres may have any relative size, they may be charged or uncharged, and the field may make any angle with their line of centers. The components of the force acting on one of the spheres along and perpendicular to the line of centers are derived and numerical results are presented. One important application of these results is in the field of cloud physics, since electrostatic effects can markedly influence the coalescence of cloud droplets.

TAB U61-2-6

GC-131. Rochester University
Mercer, T. T.
Report No. UR-475
AEC Contract No. W-7401-eng-49
48 pp.

"Charging and Precipitation Characteristics of Submicron Particles in the Rohmann Electrostatic Particle Seperator"

Feb. 14, 1957

GC-132. Rocketdyne

AD-407 758 Div. 27, 25
(TISTA/ODM)

Rocketdyne, Canoga Park, Calif.
SURFACE IONIZATION OF CESIUM WITH POROUS TUNGSTEN IONIZERS,
by R. G. Wilson, G. D. Seele and J. F. Hon.
1963, 133p. 63017
Unclassified report

Presented at the AIAA Electric Propulsion Conference, 11-13 Mar. 1963, at Broadmoor Hotel, Colorado Springs, Colo.

Descriptors: (*Electric propulsion, Ionization), (*Ionization, Electric propulsion), (*Tungsten, Surface properties), (*Cesium, Ionization), Diffusion, Porous materials, Powder metals, Sintering, Metallography, Gas flow, Analysis, Surfaces, Cleaning, Ionic current, Electric fields, Electric potential, Particles, Data, Symposia, Ion engines.

The surface ionization properties of porous tungsten ionizers which have been sintered from powders with diameters of 0.1, 0.9, 5, 8, 12 to 18, and 44 to 74 microns and with densities from 60 to 80 percent have been determined experimentally with a neutral atom and ion detector for through-fed cesium.

TAB U63-4-2

GC-133. Stanford Research Inst.

AD-255 010 Div. 3, 14, 26
(1 May 61) OTS price $4.60

Stanford Research Inst., Menlo Park, Calif.
ENCAPSULATED AEROSOLS,
by Robert C. Robbins. Final rept. 1 Apr 60-31 Mar 61. 17 Apr 61, 38p. incl. illus. tables
(Contract DA 18-108-405-cml-746, Proj. 5U-3191)
Unclassified report

DESCRIPTORS: *Aerosols, Condensation, Films, *Coatings, *Encapsulation, Benzoic acids, Vapors, Coagulation, Phthalates, Liquids, Phosphites, Phosphates, Phosphoric acids, Chlorides, Ammonium radicals, Ethylenes, Nitrogen compounds, Dioxides, Polymers, Solids, *Chemical warfare agents, Polymer solutions, Electrostatics, Polymerization.

Various methods of aerosol encapsulation were studied: (1) liquid phase microencapsulation, (2) condensation, and (3) coagulation. Aerosol encapsulation by condensation, using the core particles or droplets as condensation nuclei, proved to be a generally successful technique. Coagulation with inertial forces, using simple low-powered devices, showed little promise as a practical aerosol encapsulation method. Coagulation with electrostatic charging of the particles was only partially successful in solid on liquid and liquid on liquid systems, but worked quite well in encapsulating solid cores with liquid films. Liquid phase microencapsulation was quite successful, where applicable. A number of liquid cores were successfully polymer encapsulated, isolated, dried, and dispersed.

TAB U61-3-1